Vol I.
Encyclopaedia Britannica
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"Encyclopaedia Britannica. Vol II."
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ENCYCLOPÆDIA BRITANNICA.

VOLUME the FIRST.

Encyclopædia Britannica;

James OR, A Fullerton

DICTIONARY

OF

ARTS and SCIENCES,

COMPILED UPON A NEW PLAN.

IN WHICH

The different SCIENCES and ARTS are digested into distinct Treatises or Systems;

AND

The various TECHNICAL TERMS, *&c.* are explained as they occur in the order of the Alphabet.

ILLUSTRATED WITH ONE HUNDRED AND SIXTY COPPERPLATES.

By a SOCIETY *of* GENTLEMEN *in* SCOTLAND.

IN THREE VOLUMES.

VOL. I.

EDINBURGH:

Printed for A. BELL and C. MACFARQUHAR;

And sold by COLIN MACFARQUHAR, at his Printing-office, Nicolson-street.

M.DCC.LXXI.

P R E F A C E.

UTILITY ought to be the principal intention of every publication. Wherever this intention does not plainly appear, neither the books nor their authors have the ſmalleſt claim to the approbation of mankind.

To diffuſe the knowledge of Science, is the profeſſed deſign of the following work. What methods, it may be aſked, have the compilers employed to accompliſh this deſign? Not to mention original articles, they have had recourſe to the beſt books upon almoſt every ſubject, extracted the uſeful parts, and rejected whatever appeared trifling or leſs intereſting. Inſtead of diſmembering the Sciences, by attempting to treat them intelligibly under a multitude of technical terms, they have digeſted the principles of every ſcience in the form of ſyſtems or diſtinct treatiſes, and explained the terms as they occur in the order of the alphabet, with references to the ſciences to which they belong.

As this plan differs from that of all the Dictionaries of Arts and Sciences hitherto publiſhed, the compilers think it neceſſary to mention what they imagine gives it a ſuperiority over the common method. A few words will anſwer this purpoſe. Whoever has had occaſion to conſult Chambers, Owen, *&c.* or even the voluminous French *Encyclopedie*, will have diſcovered the folly of attempting to communicate ſcience under the various technical terms arranged in an alphabetical order. Such an attempt is repugnant to the very idea of ſcience, which is a connected ſeries of concluſions deduced from ſelf-evident or previouſly diſcovered principles. It is well if a man be capable of comprehending the principles and relations of the different parts of ſcience, when laid before him in one uninterrupted chain. But where is the man who can learn the principles of any ſcience from a Dictionary compiled upon the plan hitherto adopted? We will, however, venture to affirm, that any man of ordinary parts, may, if he chuſes, learn the principles of Agriculture, of Aſtronomy, of Botany, of Chemiſtry, *&c.* *&c.* from the ENCYCLOPÆDIA BRITANNICA.

IN the execution of this extenſive and multifarious undertaking, the Compilers laboured under many diſadvantages, partly ariſing from the nature of the work, and partly owing to the following circumſtance.

THE

The Editors, though fully ſenſible of the propriety of adopting the preſent plan, were not aware of the length of time neceſſary for the execution, but engaged to begin the publication too early. However, by the remonſtrances of the Compilers, the publication was delayed for twelve months. Still time was wanted. But the ſubſcribers puſhed the Editors, and they at laſt perſuaded the Compilers to conſent to the publication. If time had been allowed, the Compilers deſigned to have compleated the ſciences before proceeding to the technical terms; and by that means to have guarded againſt omiſſions, and made all the references from the terms to the ſciences more particular. The conſequence was unavoidable. All the references to any ſcience that occur in the alphabet previous to the name of the ſcience itſelf, are general: thoſe that follow are particular; pointing out, not only the name of the ſcience, but the number of the page.

We muſt further acknowledge, that, in ſome inſtances, we have deviated from the general plan; but, we hope, not without reaſon. For example, under the words Botany and Natural History, it would have been an endleſs, and perhaps an uſeleſs taſk, to have given the generic diſtinctions of every plant, and of every animal. Theſe are to be found under the names of the plants and animals themſelves. The ſame obſervation may be made with reſpect to *Mineralogy*, *Materia Medica*, *Pathology*, *Phyſiology*, and *Therapeutics*. Theſe are ſo interwoven with *Anatomy*, *Botany*, *Chemiſtry*, and *Medicine*, that, in a work of this kind, it was almoſt impoſſible, without many unneceſſary repetitions, to treat them as diſtinct ſciences. Indeed, properly ſpeaking, they are not ſciences, but parts or acceſſories of ſciences, which, by the dexterity of teachers and authors, have been long exhibited under that form.

With regard to errors in general, whether falling under the denomination of mental, typographical, or accidental, we are conſcious of being able to point out a greater number than any critic whatever. Men who are acquainted with the innumerable difficulties attending the execution of a work of ſuch an extenſive nature will make proper allowances. To theſe we appeal, and ſhall reſt ſatisfied with the judgment they pronounce.

In order to give ſome idea of the materials of which this Dictionary is compoſed, we ſhall conclude the preface with a liſt of the principal authors made uſe of in the compilation.

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Alston's *Tyrocinium botanicum.*
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Berthoud sur l'art de conduire et de regler les pendules et les montres.
Bartlet's farriery.
Bielfield's universal erudition.
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Cowper's *myotomia reformata.*
Crocker's dictionary of arts and sciences.
Cullen's *synopsis nosologiæ methodicæ.*
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———Logic.
Edwards's natural history.
Elmgren's *termini botanici.*
Le Grand Encyclopedie.
Erskine's institutes of the law of Scotland.
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———Optics.
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Gregory's practical geometry.
Grew's anatomy of plants.
Haartman de plantis hybridis, in Amœn. Acad.
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Harris's Hermes.
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Wahlbomii ſponſalia plantarum, in Amœn. Acad.
Dr Whytt's works.
Wildman on bees.
Willoughby's *ornithologia.*
———*Ichthyographia.*
Winſlow's anatomy.
Worceſter's natural philoſophy.
Young on compoſition.

*** *Gazetteers, Pamphlets, Magazines, and other periodical publications; beſides many books mentioned in the work itſelf.*

Encyclopædia Britannica;

Or, A NEW and COMPLETE

DICTIONARY

OF

ARTS and SCIENCES.

A, the name of ſeveral rivers in different parts of the world, viz. 1. of one in Solagne, in France; 2. of one in French Flanders; 3. of three in Switzerland; 4. of five in the Low Countries; 5. of five in Weſtphalia; 6. of one in Livonia.

AABAM, a term, among alchemiſts, for lead.

AACH, the name of a town and river in Swabia. It is alſo a name ſometimes given to Aix-la-chapelle.

AADE, the name of two rivers, one in the country of the Griſons in Switzerland, and the other in Dutch Brabant.

AAHUS, a ſmall town and diſtrict in Weſtphalia.

AAM, a Dutch meaſure for liquids, containing about 63 ℔. avoirdupoiſe.

AAMA, a province in Barbary, very little known.

AAR, the name of two rivers, one in Weſtphalia, and one in Switzerland. It is likewiſe the name of a ſmall iſland in the Baltic ſea.

AARSEO, a town in Africa, ſituated near the mouth of the river Mina.

AATTER, or Atter, a province of Arabia Felix, ſituated on the Red-ſea.---N. B. All other places which begin with a double A, but more generally with a ſingle one, will be inſerted according to the laſt orthography.

AB, the eleventh month of the civil year of the Hebrews. It correſponds to part of our June and July, and conſiſts of 30 days. On the firſt of this month the Jews commemorate the death of Aaron by a faſt: they faſt alſo on the ninth, becauſe on that day both the temple of Solomon and that erected after the captivity were burnt. The ſame day is alſo remarkable for the publication of Adrian's edict, prohibiting the Jews to look back, even when at a diſtance, upon Jeruſalem, or to lament its deſolation. The lamp of the ſanctuary, in the time of Ahaz, was extinguiſhed on the night of the 18th, for which reaſon the Jews faſt that day. See Astronomy, *Of the diviſion of time.*

AB, in the Syriac kalendar, is the name of the laſt ſummer-month.

ABACATUAIA, in ichthyology, a barbarous name of the zeus vomer, a fiſh belonging to the thoracic order of Linnæus. See Zeus.

ABACAY, a barbarous name of a ſpecies of the pſittacus, or parrot. See Psittacus.

ABACH, a town in Bavaria, ſituated on the Danube, a little above Ratiſbon.

ABACISCUS. See Abacus.

ABACO, a term, among ancient writers, for arithmetic.

ABACOA, the name of one of the Bahama iſlands. See Bahama.

ABACOT, the name of an ancient cap of ſtate worn by the kings of England, the upper part whereof was in the form of a double crown.

ABACTORES, or Abactors, a term for ſuch as carry off or drive away a whole herd of cattle by ſtealth.

ABACTUS, an obſolete term, among phyſicians, for a miſcarriage procured by art.

ABACUS, a table ſtrewed over with duſt or ſand, upon which the ancient mathematicians drew their figures. It alſo ſignified a cupboard, or buffet.

ABACUS, in architecture, ſignifies the ſuperior part or member of the capital of a column, and ſerves as a kind of crowning to both. It was originally intended to repreſent a ſquare tile covering a baſket. The form of the abacus is not the ſame in all orders: in the Tuſcan, Doric, and Ionic, it is generally ſquare; but in the Corinthian and Compoſite, its four ſides are arched inwards, and embelliſhed in the middle with

ſome ornament, as a roſe or other flower. Scammozzi uſes *abacus* for a concave moulding on the capital of the Tuſcan pedeſtal; and Palladio calls the plinth above the echinus, or boultin, in the Tuſcan and Doric orders, by the ſame name. See plate I. fig. 1. and ARCHITECTURE.

ABACUS is alſo the name of an ancient inſtrument for facilitating operations in arithmetic. It is variouſly contrived. That chiefly uſed in Europe is made by drawing any number of parallel lines at the diſtance of two diameters of one of the counters uſed in the calculation. A counter placed on the loweſt line, ſignifies 1; on the 2d, 10; on the 3d, 100; on the 4th, 1000, &c. In the intermediate ſpaces, the ſame counters are eſtimated at one half of the value of the line immediately ſuperior, viz. between the 1ſt and 2d, 5; between the 2d and 3d, 50, &c. See plate I. fig. 2. A B, where the ſame number, 1768 for example, is repreſented under both by different diſpoſitions of the counters.

ABACUS *harmonicus*, among muſicians, the arrangement of the keys of a muſical inſtrument.

ABACUS *logiſticus*, a right-angled triangle, whoſe ſides forming the right angle contain the numbers from 1 to 60, and its area the facta of every two of the numbers perpendicularly oppoſite. This is alſo called a canon of ſexageſimals.

ABACUS *Pythagoricus*, the multiplication-table, or any table of numbers that facilitates operations in arithmetic.

ABADAN, a town of Perſia, ſituated near the mouth of the Tygris.

ABADDON, from *abad*, to deſtroy; a name given by St John, in the Revelations, to the king of the locuſts.

ABADIR, a title which the Carthaginians gave to gods of the firſt order. In the Roman mythology, it is the name of a ſtone which Saturn ſwallowed, believing it to be his new-born ſon Jupiter: hence it became the object of religious worſhip.

ABÆRE, a town in the deſarts of Arabia.

ABAFT, a ſea-term, ſignifying *towards the ſtern:* for inſtance, *abaft the mizzen-maſt*, implies, that the object is between the mizzen-maſt and the ſtern.

ABAI, in botany, a ſynonime of the calycanthus præcox, a genus of plants belonging to the icoſandria polygynia claſs of Linnæus. See CALYCANTHUS.

ABAISSE. See ABASED.

ABALIENATION. See ALIENATION.

ABANBO, a river of Ethiopia which falls into the Nile.

ABANCAI, or ABANCAYS, a town and river of Peru, in the diſtrict of Lima.

ABANO, a ſmall town in Italy, ſubject to Venice, and ſituated five miles ſouth-weſt of Padua.

ABAPTISTON, or ANABAPTISTON, an obſolete term for the chirurgical inſtrument called a *trepan*. See SURGERY, and *Trepan*.

ABARCA, a ſhoe made of raw hides, formerly worn by the peaſants in Spain.

ABARTICULATION, in anatomy, a ſpecies of articulation which is now termed *diarthroſis*. See ANATOMY, Part I. and *Diarthroſis*.

ABAS, a weight uſed in Perſia for weighing pearls. It is 1-8th leſs than the European carat.

ABASCIA, the country of the Alcas. See ALCAS.

ABAISED, *Abaiſſe*, in heraldry, an epithet applied to the wings of eagles, &c. when the tip looks downwards to the point of the ſhield, or when the wings are ſhut; the natural way of bearing them being extended.

ABASING, in the ſea-language, ſignifies the ſame as ſtriking.

ABASSI, or ABASSIS, a ſilver coin current in Perſia, equivalent in value to a French livre, or tenpence halfpenny Sterling. It took its name from Schaw Abas II. king of Perſia, under whom it was ſtruck.

ABATAMENTUM, in law, is an entry to lands by interpoſition, i. e. when a perſon dies ſeized, and another who has no right enters before the heir.

ABATE, from *abatre*, to deſtroy; a term uſed by the writers of the common law, both in an active and neutral ſenſe; as, to *abate* a caſtle, is to deſtroy or beat it down; to *abate* a writ, is, by ſome exception to render it null and void.

ABATE, in the manage, implies the performance of any downward motion properly. Hence a horſe is ſaid to *abate*, or take down his curvets, when he puts both his hind-legs to the ground at once, and obſerves the ſame exactneſs in all the times.

ABATEMENT, in heraldry, implies ſomething added to a coat of arms in order to leſſen its dignity, and point out ſome imperfection or ſtain in the character of the wearer.

ABATEMENT, in law. See ABATE.

ABATEMENT, in commerce, ſignifies an allowance or diſcount in the price of certain commodities, in conſideration of prompt payment; a diminution in the ſtipulated quantity or quality of goods, or ſome ſuch circumſtance.

ABATEMENT, in the cuſtoms, an allowance made upon the duty of goods, when the quantum damaged is determined by the judgment of two merchants upon oath, and aſcertained by a certificate from the ſurveyor and land-waiter.

ABATIS, an ancient term for an officer of the ſtables.

ABATOR, in law, a term applied to a perſon who enters to a houſe or lands, void by the death of the laſt poſſeſſor, before the true heir.

ABAVO, in botany, a ſynonime of the adanſonia, a ſhrub belonging to the monadelphia polyandria of Linnæus. See ADANSONIA.

ABAYANCE. See ABEYANCE.

ABB, a term, among clothiers, applied to the yarn of a weaver's warp. They alſo ſay *Abb-wool* in the ſame ſenſe.

ABBA, in the Syriac and Chaldee languages, literally ſignifies a *father*; and figuratively, a ſuperior, reputed as a father in reſpect of age, dignity, or affection. It is alſo a Jewiſh title of honour given to ſome of the claſs called Tanaites.

ABBAT. See ABBOT.

ABBATIS. See ABATIS.

ABBEFORD, a ſea-port town in Norway, in 58. 44. N. lat.

ABBESS, the ſuperior of an abbey or convent of nuns, over whom ſhe has the ſame authority as the abbots over the monks. Their ſex indeed hinders them from performing

forming the ſpiritual functions; but in the 12th century there were abeſſes in Spain who gave benedictions, and confeſſed people of both ſexes.

ABBEVILLE, a large city of Piccardy in France, lying 90 miles north of Paris, in 50. 7. N. lat. and 2. 0. E. long.

ABBEY, a religious houſe, governed by an abbot, where perſons retire from the world, to ſpend their time in ſolitude and devotion. By the invention of maſſes for the living and the dead, diſpenſations, jubilees, indulgences, &c. the abbeys procured ſuch large privileges, exemptions, and donations, that, when theſe houſes were totally aboliſhed in England by Henry VIII. to the number of 190, an yearly revenue of L. 2,853,000 reverted to the crown.

ABBEY-BOYLE, a town in the county of Roſcommon in Ireland.

ABBOT, the ſuperior of an abbey or convent of monks. In the firſt ages of Chriſtianity, the abbots were plain diſintereſted men, and lived contented with the government of their monaſteries, which were generally erected in the moſt ſolitary parts: but being called from their deſerts to oppoſe the hereſies in the church, they ſoon began to entertain ſentiments of ambition, and endeavoured to ſhake off their dependency on the biſhops. Hence aroſe the diſtinctions of *mitred abbots*, *croſiered abbots*, *œcumenical abbots*, *cardinal abbots*, &c. The principal diſtinction which ſubſiſts at preſent among abbots, is that of *regular* and *commendatory*; the former of which take the vow, and wear the habit of the order; the latter are ſeculars, though they are obliged to take orders at the proper age. Before the Reformation in England, there were abbots elective and repreſentative; ſome mitred, and others not. The mitred abbots were inveſted with epiſcopal authority within their own limits, independent of the biſhop; but the others were ſubject to the dioceſan in all ſpiritual government. The mitred abbots were Lords of parliament, of which number Sir Edward Coke reckons 27, who ſat in parliament, beſides two Lords Priors.

ABBREVIATE *of adjudications*, in Scots law, an abſtract or abridgment of a decreet of adjudication, which is recorded in a regiſter kept for that purpoſe. See SCOTS LAW, title, *Adjudications*.

ABBREVIATION, or ABBREVIATURE, implies the ſubſtitution of a ſyllable, letter, or character, for a whole word.

ABBREVIATOR, a perſon who abridges any large book into a narrower compaſs.

ABBREVIATORS, a college of 72 perſons in the chancery of Rome, who draw up the pope's brieves, and reduce petitions into proper form.

ABBREVOIR, a term in maſonry, expreſſive of certain indentures made in the joints or beds of ſtones, which being filled with the cement or mortar, bind them firmer together.

ABBROCHMENT. See ABROCHMENT.

ABBUTTALS, ſignify the buttings or boundings of land towards any point. Limits were anciently diſtinguiſhed by artificial hillocks, which were called *botentines*, and hence *butting*. In a deſcription of the ſite of land, the ſides on the breadth are more properly *adjacentes*, and thoſe terminating the length are *abbutantes*; which, in old ſurveys, were ſometimes expreſſed by *capitare*, to head; whence abbuttals are now called *head lands*.

ABCASSES, a people or country in Aſia, ſituate between Circaſſia, the Black-ſea, and Mingrelia.

ABCDARIA, in botany, a ſynonime of the verbeſina acmella. See VERBESINA.

ABCDARY, or ABCDARIAN, an epithet applied to compoſitions, whoſe parts are diſpoſed in an alphabetical order.

ABDALS, or *ſervants of God*, in the Eaſtern countries; furious enthuſiaſts, who frequently run about the ſtreets, deſtroying all who differ from them in religious opinions.

ABDELAVI, in botany, a name uſed by Arabian writers for a ſpecies of cucumis. See CUCUMIS.

ABDEST, a term uſed for the legal purifications by water, practiſed among the Mahometans and Perſians before they begin their religious ceremonies.

ABDICARIAN *propoſition*, in logic, the ſame with a negative one. See LOGIC, and *Propoſition*.

ABDICATION, the action of renouncing or giving up an office.

ABDOMEN, in anatomy, is that part of the trunk of the body which lies between the thorax and the bottom of the pelvis. See ANATOMY, part VI.

ABDUCTION, a form of reaſoning among logicians, which conſiſts in drawing concluſions from certain and undeniable propoſitions. See LOGIC.

ABDUCTION, in ſurgery, a ſpecies of fracture wherein the broken parts of the bone recede from each other. See SURGERY, *Of fractures*.

ABDUCTOR, in anatomy, the name of ſeveral muſcles which ſerve to open or draw back the parts to which they are fixed. See ANATOMY, Part VI.

ABEL-TREE, or ABELE-TREE, an obſolete name for a ſpecies of the poplar. See POPULUS.

ABELIANS, ABELOITES, or ABELONIANS, a ſect of heretics that ſprung up near Hippo in Africa during the reign of Arcadius. They had one diſtinguiſhing and extraordinary tenet, which was to marry, but never to conſummate.

ABELMOSCH, or ABELMUSCH, in botany, the trivial name of a ſpecies of the hibiſcus. See HIBISCUS.

ABENSBURG, or ABENSPERG, a ſmall town in Bavaria, on the river Abenæ, near the Danube.

ABERBROTHOCK, one of the royal boroughs of Scotland, ſituated in the county of Angus; about 40 miles north of Edinburgh. Its weſt long. is 2. 20. and N. lat. 56. 30. There was formerly one of the richeſt monaſteries in Scotland in this town. It was founded by King William of Scotland about the year 1170, in honour of Thomas Becket Archbiſhop of Canterbury, with whom he is ſaid to have been intimately acquainted. This monaſtery received conſiderable donations from Gilchriſt Earl of Angus, and Gilbred his ſon. It was poſſeſſed by the monks of St Bennet. The inhabitants of Aberbrothock, for the

ſake

ſake of their monaſtery, were made deniſons of all England (London excepted) by King John.

ABERDEEN, the name of two cities in Scotland, called the *Old* and *New Towns*, ſituated on the German Ocean, in 1 45. W. lon. and 57. 11. N. lat.

The old town lies about a mile to the north of the new, at the mouth of the river Don, over which is a fine bridge, of a ſingle arch, which reſts at both ſides on two rocks. The old town was formerly the ſeat of the biſhop, and had a large cathedral church, commonly called *St Macher's*. This cathedral had anciently two rows of ſtone pillars acroſs the church, and three turrets; the ſteeple, which was the largeſt of theſe turrets, reſted upon an arch, ſupported by four pillars. In this cathedral there was a fine library; but about the year 1560 it was almoſt totally deſtroyed

But the capital building is the King's-college, on the ſouth ſide of the town, which is a large and ſtately fabric. The ſteeple is vaulted with a double croſs arch, above which is an imperial crown, ſupported by eight ſtone pillars, and cloſed with a globe and two gilded croſſes. In the year 1631 this ſteeple was thrown down by a ſtorm, but was ſoon after rebuilt in a more ſtately form. This college was founded by Biſhop Elphinſton in the year 1500; but James IV. claimed the patronage of it, and it has ſince been called the *King's College*. This college, and the Mariſhall-college in the new town, form one univerſity, called the *Univerſity of King Charles*.

The new town is the capital of the ſhire of Aberdeen. For largeneſs, trade, and beauty, it greatly exceeds any town in the North. It ſtands upon a hill or riſing ground. The buildings are generally four ſtories high, and have, for the moſt part, gardens behind them, which gives it a beautiful appearance. On the high ſtreet is a large church, which formerly belonged to the Franciſcans. This church was begun by Bp William Elphinſton, and finiſhed by Gavinus Dunbar, Biſhop of Aberdeen, about the 1500. Bp Dunbar is ſaid likewiſe to have built the bridge over the Dee, which conſiſts of ſeven arches. The chief public building in the new town is the Mariſhall-college, founded by George Keith Earl of Marſhall, in the year 1593; but has ſince been greatly augmented with additional buildings. In both the Mariſhall and King's-college the languages, mathematics, natural philoſophy, divinity, *&c.* are taught by very able profeſſors

ABERDOUR, a ſmall town in Fifeſhire, Scotland, on the frith of Forth, about ten miles N. W. of Edinburgh.

ABERGAVENY, in Monmouthſhire, England, a well-built town, lying 142 miles W. by N. of London, in 51. 50. N. lat. and 30. 5 W lon. This town conſiſts of about 500 houſes, has a weekly market on the Tueſdays, and another on the Fridays; and three fairs for horſes, ſheep, and black cattle.

ABERMURDER, an old law-term for murder, proved in a judicial manner, which could not be atoned for with money.

ABERRATION, in aſtronomy, a ſmall apparent motion of the fixed ſtars, firſt diſcovered by Dr Bradley and Mr Mollineux, and found to be owing to the progreſſive motion of light, and the earth's annual motion in its orbit. If a lucid object be fixed, and the eye of the obſerver moving along in any other direction than that of a ſtreight line from the eye to the object, it is plain, that the object muſt have an apparent motion, greater or leſs, according to the velocity with which the eye is moved, and the diſtance of the object from the eye. See ASTRONOMY.

ABERRATION, in optics, a deviation of the rays of light which prevents their uniting in the ſame focal point, and is occaſioned by their being refracted by a ſpherical lens, or reflected by a ſpherical ſpeculum. See OPTICS.

ABERYSWITH, a market-town in Wales, lying 199 miles W. S. W. of London, in 52. 30. N. lat. and 40 15 W. long.

ABESTA, the name of one of the ſacred books of the Perſian magi, which they aſcribe to their great founder Zoroaſter The abeſta is a commentary on two others of their religious books called *Zend* and *Pazend*; the three together including the whole ſyſtem of the Ignicold, or worſhippers of fire

ABESTON, a blundering way of writing Abeſtus. See ABESTUS.

ABETTOR, a law-term, implying one who encourages another to the performance of ſome criminal action, or who is art and part in the performance itſelf. Treaſon is the only crime in which abettors are excluded by law, every individual concerned being conſidered as a principal. It is the ſame with *art and part* in the Scots law.

ABEVACUATION, in medicine, a gentle evacuation. See EVACUATION.

ABEX, the name of a large tract of land, lying along the weſt coaſt of the Red-ſea, ſouth of Egypt, ſubject to the Ottoman Porte.

ABEYANCE, in law, the expectancy of an eſtate. Thus if lands be leaſed to one perſon for life, with reverſion to another for years, the remainder for years is an abeyance till the death of the leſſee.

ABHEL, in botany, an obſolete name of the ſabina or ſavin. See JUNIPER and SABINA.

ABIB, ſignifying an ear of corn, a name given by the Jews to the firſt month of their eccleſiaſtical year, afterwards called *Niſan*. It commenced at the vernal equinox, and, according to the courſe of the moon, by which their months were regulated, anſwered to the latter part of our March, and beginning of April.

ABIDING *by a writing*, in Scots law: When a perſon founds upon a writing alledged to be falſe, he may be obliged to declare judicially, whether he will ſtand or abide by it as a true deed. As to the conſequences of abiding by, or paſſing from, a falſe deed, ſee SCOTS LAW, title, *Crimes*.

ABIES, the fir-tree, in botany, belongs to the monœcia monadelphia claſs of Linnæus. For its characters, ſee PINUS, of which it is a ſpecies.

ABIGEAT, an old law-term, denoting the crime of ſtealing cattle by droves or herds. This crime was more ſeverely puniſhed than *furtum*, the delinquent being

being often condemned to the mines, banishment, and sometimes capitally.

ABIGEATUS, or ABACTUS, among physicians, signifies a miscarriage effected by art.

ABIGIES, a term in the Roman law, applied to one who had been guilty of the crime ABIGEAT; which see.

ABILITY, a term in law, denoting a power of doing certain actions in the acquisition or transferring of property.

ABINGDON, a town of Berkshire, England, seated on the Thames, about 55 miles W. of London, and gives title of Earl to the noble family of Bertie.

AB-INTESTATE, in the civil law, is applied to a person who inherits the right of one who died intestate, or without making a will. See INTESTATE.

ABISHERING, a term found in old law books, denoting a liberty or freedom from all amerciaments, and a right to exact forfeitures of others.

ABIT, or ABOIT, obsolete terms for ceruse or white lead. See CERUSE and CHEMISTRY.

ABJURATION, in our ancient customs, implied an oath, taken by a person guilty of felony, and who had fled to a place of sanctuary, whereby he solemnly engaged to leave the kingdom for ever.

ABJURATION, is now used to signify the renouncing, disclaiming, and denying, upon oath, the Pretender to have any kind of right to the crown of these kingdoms.

ABJURATION *of heresy*, the solemn recantation of any doctrine as false and wicked.

ABLAC, a small river in Swabia, which falls into the Danube not far from Furstenburg.

ABLACTATION, the weaning a child from the breast. See WEANING.

ABLACTATION, in gardening, signifies grafting by approach. See GRAFTING and GARDENING.

ABLACQUEATION, an old term in gardening, signifies the operations of removing the earth and baring the roots of trees in winter, to expose them more freely to the air, rain, snows, *&c.*

ABLATIVE, is the 6th case in Latin grammar, and peculiar to that language. It is opposed to the dative, which expresses the action of *giving*, and the ablative that of *taking away*.

ABLAY, or ABLAI, a country of Great Tartary, whose inhabitants, called *Bochars*, are vassals of the Russians. It lies to the east of the Irtis, and extends 500 leagues along the southern frontiers of Siberia.

ABLECTI, in Roman antiquity, a select body of soldiers chosen from among those called EXTRAORDINARII, which see.

ABLEGMINA, among the ancient Romans, signified those parts in the intrails of victims which were sprinkled with flour, and burnt upon the altar, in sacrificing to the gods.

ABLET, or ABLEN, an obsolete name of the fish called *Cyprinus*. See CYPRINUS.

ABLUENTS, in medicine, are the same with diluters.

ABLUTION, a ceremony used by the ancient Romans before they began the sacrifice, which consisted in washing the body. They very probably learned this ceremony from the Jews, as have also the Mahometans, who still practise it with the utmost strictness.

ABLUTION, among chemists, the sweetening any matter impregnated with salts, by repeatedly washing it with pure water. See CHEMISTRY.

ABLUTION, with physicians, is either the washing of any external part by bathing, or of the stomach and intestines by diluting liquors.

ABO, a city of Sweden, capital of Finland, seated at the mouth of the river Aurojoks on the gulph of Bothnia, 24. 0. N. E. of Stockholm, in lat. 60. 30. N. and long. 21. 30. E.

ABOARD, signifies any part on the deck or inside of a ship; hence any person who goes on the deck, or into the apartments of a ship, is said to go aboard.

ABOLITION, implies the act of annulling, destroying, making void, or reducing to nothing. In law, it signifies the repealing any law or statute.

ABOLLA, the name of a military garment worn by the Greeks and Romans.

ABOMASUS, ABOMASUM, or ABOMASIUS, names of the fourth stomach of ruminating animals. The first stomach is called *venter*, the second *reticulum*, the third *omasus*, and the fourth *abomasus*. The third stomach, omasis, is endued with the singular quality of curdling milk. But the truth is, the stomachs of almost all animals, whether they ruminate or not, will produce the same effect, though not perhaps in an equal degree, as the stomachs of calves or lambs. See MILK, RUNNET.

ABOMINATION, a term used in scripture to express idols, idolatry, *&c.*

ABORIGINES, an epithet applied to the original or first inhabitants of any country, but particularly used to signify the ancient inhabitants of Latium, or country now called *Campagna di Roma*, when Æneas with his Trojans came into Italy.

ABORTION, in midwifery, the birth of a fœtus before it has acquired a sufficient degree of perfection to enable it to perform respiration and the other vital functions. See MIDWIFERY, title, *Of abortions*.

ABORTION, among gardeners, signifies such fruits as, being produced too easy, never arrive at maturity.

ABORTIVE, in a general sense, implies any thing which comes before its proper time, or miscarries in the execution.

ABOY, a small town in Ireland, in the province of Leinster.

ABRA, a silver coin of Poland, in value nearly equivalent to an English shilling.

ABRACADABRA, a magical word or spell, which being written as many times as the word contains letters, and omitting the last letter of the former every time, was, in the ages of ignorance and superstition, worn about the neck, as an antidote against agues and several other diseases

ABRAHAM's *balm*, in botany, See CANNABIS.

ABRAHAMITES, an order of monks exterminated for idolatry by Theophilus in the ninth century. Also the name of another sect of heretics who had adopted the errors of Paulus. See PAULICIANS.

ABRAMIS, an obsolete name for the fish cyprinus. See CYPRINUS.

B ABRASA,

ABRASA, in furgery, ulcers, where the fkin is fo tender and lax as to render them fubject to abrafion.

ABRASION, in medicine, the corroding of any part by acrid humours or medicines.

ABRAUM, an obfolete name of a certain fpecies of clay, called by fome authors *Adamic earth*, on account of its red colour.

ABRASAX, or Abraxas, a myftical term found in the ancient theology and philofophy of Bafilides's followers.

ABRAX, an antique ftone with the word *abraxas* engraved on it. They are of various fizes, and moft of them as old as the third century.

ABREAST, a fea-term. In an attack, purfuit, or retreat at fea, the fquadrons or divifions of a fleet are often obliged to vary their difpofitions, and at the fame time obferve a proper regularity, by failing in right or curved lines: when they fail at a proper diftance from each other, and are all equally forward, they are then faid to have formed the line *abreaft*.

ABRENUNCIATION. See Renunciation.

ABRIDGEMENT, in literature, a term fignifying the reduction of a book into a fmaller compafs.—The art of conveying much fentiment in few words, is the happieft talent an author can be poffeffed of. This talent is peculiarly neceffary in the prefent ftate of literature; for many writers have acquired the dexterity of fpreading a few tritical thoughts over feveral hundred pages. When an author hits upon a thought that pleafes him, he is apt to dwell upon it, to view it in different lights, to force it in improperly, or upon the flighteft relations. Though this may be pleafant to the writer, it tires and vexes the reader. There is another great fource of diffufion in compofition. It is a capital object with an author, whatever be the fubject, to give vent to all his beft thoughts. When he finds a proper place for any of them, he is peculiarly happy. But, rather than facrifice a thought he is fond of, he forces it in by way of digreffion, or fuperfluous illuftration. If none of thefe expedients anfwer his purpofe, he has recourfe to the margin, a very convenient apartment for all manner of pedantry and impertinence. There is not an author, however correct, but is more or lefs faulty in this refpect. An abridger, however, is not fubject to thefe temptations. The thoughts are not his own; he views them in a cooler and lefs affectionate manner; he difcovers an impropriety in fome, a vanity in others, and a want of utility in many. His bufinefs, therefore, is to retrench fuperfluities, digreffions, quotations, pedantry, *&c.* and to lay before the public only what is really ufeful. This is by no means an eafy employment: To abridge fome books, requires talents equal, if not fuperiour, to thofe of the author. The facts, manner, fpirit, and reafoning, muft be preferved; nothing effential, either in argument or illuftration, ought to be omitted. The difficulty of the tafk is the principal reafon why we have fo few good abridgements: Wynne's abridgement of Locke's Effay on the Human Underftanding is, perhaps, the only unexceptionable one in our language.

Thefe obfervations relate folely to fuch abridgements as are defigned for the public. But,

When a perfon wants to fet down the fubftance of any book, a fhorter and lefs laborious method may be followed. It would be foreign to our plan to give examples of abridgements for the public: But, as it may be ufeful, efpecially to young people, to know how to abridge books for their own ufe, after giving a few directions, we fhall exhibit an example or two, to fhew with what eafe it may be done.

Read the book carefully; endeavour to learn the principal view of the author; attend to the arguments employed: When you have done fo, you will generally find, that what the author ufes as new or additional arguments, are in reality only collateral ones, or extenfions of the principal argument. Take a piece of paper, or a common-place book, put down what the author wants to prove, fubjoin the argument or arguments, and you have the fubftance of the book in a few lines. For example,

In the Effay on Miracles, Mr Hume's defign is to prove, That miracles which have not been the immediate objects of our fenfes, cannot reafonably be believed upon the teftimony of others.

Now, his argument, (for there happens to be but one), is,

"That experience, which in fome things is variable, in others uniform, is our *only* guide in reafoning concerning matters of fact. A variable experience gives rife to probability only; an uniform experience amounts to a proof. Our belief of any fact from the teftimony of eye-witneffes, is derived from no other principle than our experience in the veracity of human teftimony. If the fact attefted be miraculous, here arifes a conteft of two oppofite experiences, or proof againft proof. Now, a miracle is a violation of the laws of nature; and as a firm and unalterable experience has eftablifhed thefe laws, the proof againft a miracle, from the very nature of the fact, is as complete as any argument from experience can poffibly be imagined; and if fo, it is an undeniable confequence, that it cannot be furmounted by any proof whatever derived from human teftimony."

In Dr Campbell's Differtation on Miracles, the author's principal aim is to fhew the fallacy of Mr Hume's argument; which he has done moft fuccefsfully by another fingle argument, as follows:

"The evidence arifing from human teftimony *is not folely* derived from experience: on the contrary, teftimony hath a natural influence on belief antecedent to experience. The early and unlimited affent given to teftimony by children gradually contracts as they advance in life: it is, therefore, more confonant to truth, to fay, that our *diffidence* in teftimony is the refult of experience, than that our *faith* in it has this foundation. Befides, the uniformity of experience, in favour of any fact, is not a proof againft its being reverfed in a particular inftance. The evidence arifing from the fingle teftimony of a man of known veracity will go far to

" eftablifh

" eſtabliſh a belief in its being actually reverſed: If " his teſtimony be confirmed by a few others of the " ſame character, we cannot with-hold our aſſent to " the truth of it. Now, though the operations of na- " ture are governed by uniform laws, and though we " have not the teſtimony of our ſenſes in favour of a- " ny *violation* of them, ſtill, if, in particular inſtan- " ces, we have the teſtimony of *thouſands* of our fel- " low-creatures, and thoſe too men of ſtrict integri- " ty, ſwayed by no motives of ambition or intereſt, " and governed by the principles of common ſenſe, " That they were actually eye-witneſſes of theſe vio- " lations, the conſtitution of our nature obliges us to " believe them."

Theſe two examples contain the ſubſtance of about 400 pages.—Making private abridgements of this kind has many advantages; it engages us to read with accuracy and attention; it fixes the ſubject in our minds; and, if we ſhould happen to forget, inſtead of reading the books again, by glancing a few lines, we are not only in poſſeſſion of the chief arguments, but recall in a good meaſure the author's method and manner.

Abridging is peculiarly uſeful in taking the ſub ſtance of what is delivered by Profeſſors, *&c.* It is impoſſible, even with the aſſiſtance of ſhort-hand, to take down, *verbatim*, what is ſaid by a public ſpeaker. Beſides, although it were practicable, ſuch a talent would be of little uſe. Every public ſpeaker has circumlocutions, redundancies, lumber, which deſerve not to be copied. All that is really uſeful may be comprehended in a ſhort compaſs. If the plan of the diſcourſe, and arguments employed in ſupport of the different branches be taken down, you have the whole. Theſe you may afterwards extend in the form of a diſcourſe dreſſed in your own language. This would not only be a more rational employment, but would likewiſe be an excellent method of improving young men in compoſition, an object too little attended to in all our univerſities. Beſides, it would be more for the honour of profeſſors; as it would prevent at leaſt ſuch immenſe loads of disjointed and unintelligible rubbiſh from being handed about by the name of ſuch a man's lectures.

Abridgement, in law, ſignifies the making a declaration or plaint ſhorter by leaving out ſomething

Abridgement, in arithmetic. See Arithmetic, *Of vulgar fractions*

Abridgement, in algebra. See Algebra, *Of equations*.

ABROBANIA, a town and diſtrict in Tranſylvania.

ABROCHMENT, an old law term which ſignifies foreſtalling. See Forestalling.

ABROGATION, ſignifies annulling, making void, or repealing a law.

ABROLKOS, the name of certain ſhelves, or banks of ſand, about 20 leagues from the coaſt of Brazil

ABRON, a river of France which falls into the Loire not far from Nevers

ABRONO. See Abrugi.

ABROTANOIDES, the name of a ſpecies of coral called *porus*. It is alſo a ſynonime of the artemiſia. See Artemisia.

ABROTANOIDES, a wine mentioned by Dioſcorides, impregnated with ſuthernwood.

ABROTANUM, in botany, a ſynonime of ſeveral plants. See Artemisia, Filago, Santolina.

ABRUPTION, in ſurgery. See Abduction.

ABRUS, in botany, the trivial name of the glycine. See Glycine.

ABRUZZO, in geography, the name of two provinces belonging to the K. of Naples, on the gulph of Venice, diſtinguiſhed by Nearer and Farther Abruzzo, from their poſition with reſpect to Naples.

ABSCEDENTIA, in ſurgery, a term applied to decayed parts of the body, which, in a morbid ſtate, are ſeparated from the ſound, or loſe that union which was preſerved in a natural ſtate.

ABSCESS, in medicine and ſurgery, an impoſthume, or any tumor or cavity containing purulent matter. See Surgery, title, *Of tumours or abſceſſes*.

ABSCHARON, a town in Aſia, ſituated on the weſtern ſhore of the Caſpian ſea.

ABSCISSE, in mathematics. See Conic Sections,

ABSCISSION, a figure in rhetoric, whereby the ſpeaker ſtops ſhort in the middle of his diſcourſe, leaving the audience to make the inference.

Abscission, in ſurgery, the ſame with amputation.

ABSCONSA, a dark lanthorn uſed by the monks at the ceremony of burying their dead.

ABSENCE, in Scots law: When a perſon cited before a court does not appear, and judgment is pronounced, that judgment is ſaid to be *in abſence* No perſon can be tried criminally in abſence. See Law, title, *Sentences and their execution*.

ABSINTHIATED *medicines*, ſuch as are impregnated with abſinthium or wormwood.

ABSINTHIUM, in botany, the trivial name of the common wormwood or artemiſia. It is alſo a ſynonime of the tanacetum incanum, the ſenecio incanum, the anthemis montana, the achillæa egyptiaca, and of the parthenium hyſterophorus. See Artemisia, *&c.*

ABSIS, in aſtronomy, the ſame with Apsis, which ſee.

ABSOLUTE, in a general ſenſe, denotes a thing's being independent of, or unconnected with, any other; it is alſo uſed to expreſs freedom from all limitation.

Absolute *government*, is that wherein the prince, unlimited by the laws, is left ſolely to his own will. See Government.

Absolute *gravity*, in phyſics, is the whole force by which a body is urged downwards. See Mechanics.

Absolute, in metaphyſics, denotes a being that poſſeſſes independent exiſtence.

ABSOLUTION, in general, is the pardoning or forgiving a guilty perſon.

Absolution, in civil law, is a ſentence whereby the party accuſed is declared innocent of the crime laid to his charge.

Absolution, in the canon law, is a juridical act whereby the eccleſiaſtical officers remit or forgive the penitent offender, or declare him reſtored to the privileges of innocence in conſideration of his repentance.

ABSORBENT

ABSORBENT *medicines*, teſtaceous powders, as chalk, crabs-eyes, *&c.* which are taken inwardly for drying up or abſorbing any acrid or redundant humours in the ſtomach or inteſtines, They are likewiſe applied outwardly to ulcers or ſores with the ſame intention.

ABSORBENT *veſſels*, in anatomy, a name given promiſcuouſly to the lacteal veſſels, lymphatics, and inhalent arteries. See ANATOMY.

ABSORBENT *veſſels*, is alſo a name uſed for the ſmall fibrous roots of plants.

ABSORPTION, in the animal œconomy, is the act whereby the abſorbent veſſels imbibe the juices, *&c.*

ABSTEMIOUS, an epithet applied to perſons very temperate in eating and drinking. It is likewiſe applied to thoſe who could not partake of the euchariſt on account of their averſion to wine.

ABSTENTUS, in law, an heir who is with-held by his tutor from entering upon his inheritance.

ABSTERGENT *medicines*, thoſe employed for reſolving obſtructions, concretions, *&c.* ſuch as ſoap, *&c.*

ABSTINENCE, the refraining from ſomething we have a propenſity to. It commonly imports a ſpare diet.

ABSTINENTS, in church hiſtory, a ſort of people in the ancient church who carried their abſtinence and mortification very far. They have been claſſed with heretics, though we have no certain account of their particular opinions.

ABSTRACT *idea*, in metaphyſics, is a partial idea of a complex object, limited to one or more of the component parts or properties, laying aſide or abſtracting from the reſt. Thus, in viewing an object with the eye, or recollecting it in the mind, we can eaſily abſtract from ſome of its parts or properties, and attach ourſelves to others: we can attend to the redneſs of a cherry, without regard to its figure, taſte, or conſiſtence. See ABSTRACTION, METAPHYSICS.

ABSTRACT *terms*, words that are uſed to expreſs abſtract ideas. Thus beauty, uglineſs, whiteneſs, roundneſs, life, death, are abſtract terms.

ABSTRACT *mathematics*, ſometimes denominated *pure mathematics*, treat of magnitude or quantity abſolutely and generally conſidered, without regard to any particular ſpecies of magnitude.

ABSTRACT *numbers*, ſuch as have no particular application.

ABSTRACT, is alſo a term in literature to ſignify a conciſe, yet general view or analyſis of ſome larger work. It differs from an abridgment, in being ſhorter and more ſuperficial; and from an extract, as this laſt is a copy of ſome part or paſſage of it.

ABSTRACTION, the operation of the mind when occupied by abſtract ideas. A large oak fixes our attention, and abſtracts us from the ſhrubs that ſurround it. In the ſame manner, a beautiful woman in a crowd, abſtracts our thoughts, and engroſſes our attention ſolely to herſelf. Theſe are examples of real abſtraction: when theſe, or any others of a ſimilar kind, are recalled to the mind, after the objects themſelves are removed from our ſight, they form what is called *abſtract ideas*, or the mind is ſaid to be employed in abſtract ideas. But the power of abſtraction is not confined to objects that are ſeparable in reality as well as mentally: the ſize, the figure, the colour of a tree are inſeparably connected, and cannot exiſt independent of each other; and yet we can mentally confine our obſervations to any one of theſe properties, neglecting or abſtracting from the reſt.

ABSTRACTION, in chemiſtry, the evaporating or drawing off the menſtruum from any ſubject.

ABSTRACTITIOUS, an obſolete term, among chemiſts, for a vegetable ſpirit obtained without fermentation.

ABSTRUSE, a term applied to any thing that is hard to be underſtood, whether the obſcurity ariſes from the difficulty of the ſubject, or the confuſed manner of the writer.

ABSURD, an epithet for any thing that contradicts an apparent truth.

ABSURDITY, the name of an abſurd action or ſentiment.

ABSUS, in botany, the trivial name of a ſpecies of the caſſia.

ABSYNTHIUM. See ABSINTHIUM.

ABUAI, one of the Philippine iſles. See PHILIPPINE.

ABUCCO, ABOCCO, or ABOOCHI, a weight uſed in the kingdom of Pegu, equal to 12½ teccalis; two abuccos make an agiro; and two agiri make half a biza, which is equal to 2 ℔ 5 oz. of the heavy weight of Venice.

ABUKESO. See ASLANI.

ABUNA, the title of the Archbiſhop or Metropolitan of Abyſſinia.

ABUNDANT *numbers*, ſuch whoſe aliquot parts added together exceed the number itſelf; as 20, the aliquot parts of which are, 1, 2, 4, 5, 10, and make 22.

ABUSAN, an iſland on the coaſt of Africa, in 35. 35. N lat dependent on the province of Garet, in the kingdom of Fez.

ABUSE, implies the perverting of any thing from its original intention.

ABUTIGE, a town in Upper Egypt, famous for producing the beſt opium.

ABUTTALS. See ABBUTTALS.

ABUTILON, in botany, the trivial name of ſeveral ſpecies of the ſida. See SIDA. Abutilon is alſo a ſynonime of the melochia tomentoſa, and melochia depreſſa, two American plants of the monadelphia pentandria claſs. It it is likewiſe a ſynonime of the lavatora, malva, and hibiſcus.

ABYSS, in a general ſenſe, ſignifies any unfathomable gulph. It is alſo the name of a vaſt cavern filled with water, ſuppoſed to exiſt near the centre of the earth.

ABYSS, in ſcripture, is ſometimes uſed for hell.

ABYSS, in antiquity, a name given to the temple of Proſerpine,

ABYSS, among alchemiſts, ſignifies the receptacle of the ſeminal matter, and ſometimes the ſeminal matter itſelf.

ABYSSINIA, a kingdom of Africa, bounded on the N. by that of Sennar, or Nubia; on the E. partly by the Red ſea, and partly by Dancala; on the W. by Gorham and Gingiro; and on the S. by Alaba and Ommo-Zaidi. It was formerly of greater

extent

extent than it is at present, because several provinces have revolted, and the Turks have made encroachments to the east. The land is fertile in many places, and the air is very hot, except in the rainy season, and then it is very temperate. For four months in the year, greater rains fall there than perhaps in any other part of the world, which occasion the swelling of the river Nile, that has its source in this country. It contains mines of all sorts of metal, except tin; but the inhabitants make no great advantage thereof. The fields are watered by several streams, except in the mountainous parts. The emperor, or king, is called *Negus;* and he has been commonly taken for Prester John. His authority is absolute, and he often dwells with his whole court in tents. However, Abyssinia is not without cities, as some pretend; for Gondar is a large place, where the king commonly resides when he is not in the field. The inhabitants are black, or very near it; but they are not so ugly as the negroes. They make profession of the Christian religion, but it has a mixture of Judaism. The habit of persons of quality is a silken vest, with a sort of scarf; but the common people wear nothing but a pair of drawers.

ABYSSINIAN *church*, that established in the empire of Abyssinia. It is a branch of the Copts or Jacobites, a sect of heretics, who admit but one nature in Jesus Christ.

ACACALOTL, the Brasilian name of a species of the Corvus. See CORVUS.

ACACIA, in botany, a synonime of the poinciana, genista, mimosa, robinia, guaicum, *&c.* See these articles.

ACACIA, in the materia medica, the inspissitated juice of the unripe fruit of the acacia. This juice is brought from Egypt in roundish pieces, wrapt up in thin bladders, and is used as a mild astringent.

ACACIA *germanica*. See PRUNA.

ACACIA, among antiquaries, something resembling a roll or bag, seen on medals, as in the hands of several consuls and emperors. Some take it to represent a handkerchief rolled up, wherewith they made signals at the games; others a roll of petitions or memorials; and some a purple bag full of earth, to remind them of their mortality.

ACACIANS, in ecclesiastical history, the name of several sects of heretics; some of whom maintained, that the Son was only a similar, not the same, substance with the Father; and others, that he was not only a distinct, but a dissimilar substance. Two of these sects had their denomination from Acacius bishop of Cæsarea, who lived in the fourth century, and changed his opinions, so as, at different times, to be head of both. Another was named from Acacius patriarch of Constantinople, who lived in the close of the fifth century.

ACADEMIC, ACADEMICIAN, or ACADEMIST, a member of an academy. See ACADEMY in the modern sense.

ACADEMICS, or ACADEMISTS, a denomination given to the cultivators of a species of philosophy originally derived from Socrates, and afterwards illustrated and inforced by Plato, who taught in a grove near Athens, consecrated to the memory of Academus an Athenian hero; from which circumstance this philosophy received the name of *academical*. Before the days of Plato, philosophy had, in a great measure, fallen into contempt. The contradictory systems and hypotheses that had successively been urged upon the world, were become so numerous, that, from a view of this inconstancy and uncertainty of human opinions, many were led to conclude, that truth lay beyond the reach of our comprehension. Absolute and universal scepticism was the natural consequence of this conclusion. In order to remedy this abuse of philosophy and of the human faculties, Plato laid hold of the principles of the academical philosophy, and, in his Phædo, reasons in the following manner: "If we are unable to discover "truth, (says he), it must be owing to two circum-"stances; either there is no truth in the nature of "things, or the mind, from a defect in its powers, "is not able to apprehend it. Upon the latter suppo-"sition, all the uncertainty and fluctuation in the opi-"nions and judgments of mankind admit of an easy "solution: Let us therefore be modest, and ascribe "our errors to the real weakness of our own minds, "and not to the nature of things themselves. Truth "is often difficult of access: in order to come at it, "we must proceed with caution and diffidence, care-"fully examining every step; and after all our labour, "we will frequently find our greatest efforts disap-"pointed, and be obliged to confess our ignorance "and weakness."

Labour and caution in our researches, in opposition to rash and hasty decisions, were the distinguishing characteristics of the disciples of the ancient academy. A philosopher possessed of these principles, will be slow in his progress, but will seldom fall into errors, or have occasion to alter his opinion after it is once formed. Vanity and precipitance are the great sources of scepticism: hurried on by these, instead of attending to the cool and deliberate principles recommended by the academy, several of our modern philosophers have plunged themselves into an absurd and ridiculous kind of scepticism. They pretend to discredit things that are plain, simple, and easily comprehended; but give peremptory and decisive judgments upon subjects that evidently exceed the limits of our capacity. Of these Berkley and Hume are the most considerable. Berkley denied the existence of every thing, excepting his own ideas. Mr Hume has gone a step further, and questioned even the existence of ideas; but at the same time has not hesitated to give determined opinions with regard to eternity, providence, and a future state, miraculous interpositions of the Deity, *&c.* subjects far above the reach of our faculties. In his essay on the academical or sceptical philosophy, he has confounded two very opposite species of philosophy. After the days of Plato, indeed, the principles of the first academy were grossly corrupted by Arcesilas, Carneades, *&c.* This might lead Mr Hume into the notion that the *academical* and *sceptical* philosophy were synonimous terms. But no principles can be of a more opposite nature

than thoſe which were inculcated by the old academy of Socrates and Plato, and the ſceptical notions which were propagated by Arceſilas, Carneades, and the other diſciples of the ſucceeding academics.

ACADEMY, in antiquity, a garden or villa, ſituated within a mile of Athens, where Plato and his followers held their philoſophical conferences. It took its name from one Academus, or Ecademus, a citizen of Athens, who was the original owner of it, and made it a kind of gymnaſium: he lived in the time of Theſeus. Cimon embelliſhed it with fountains, trees, and walks; but Sylla, during the ſiege of Athens, employed theſe very trees in making battering-engines againſt the city. Cicero too had his villa, or place of retirement, near Puzzuoli, which he alſo named an academy, where he compoſed his *Academical queſtions*, and his book *De natura deorum*.

ACADEMY, among the moderns, is moſt commonly uſed to ſignify a ſociety of learned men, eſtabliſhed for the improvement of any art or ſcience. Charlemagne was the firſt that eſtabliſhed an academy in Europe. Moſt nations have ſince followed his example; but Italy has by far the greateſt number. In the cities of Piedmont, Ferrara, and Milan, Jarckius reckons 550. We have but few in Britain. In England thoſe of note are, the Royal Society, the Antiquarian Society, Society for the encouragement of arts, and the Academy of Painting; in Scotland, the Edinburgh Society, College of Phyſicians, and Muſical Society; all which ſee in their proper places.

The French have ſeveral academies; as, the Royal Academy of Sciences, for the improvement of phyſics, mathematics, and chemiſtry. It was firſt inſtituted in 1666, by the aſſiſtance of Mr Colbert, comptroller-general of the finances, but was not confirmed by the French king till the year 1696, who, by a regulation dated the 26th of January, new-modelled and put it on a better footing. According to this regulation, the academy was to be compoſed of ten honorary academicians, eight ſtrangers aſſociates, twenty penſionaries fellows, twenty eleves or ſcholars, and twelve French aſſociates; theſe were to be divided into ſix claſſes, *viz.* geometricians, aſtronomers, mechanics, anatomiſts, chemiſts, and botaniſts; the honorary academiſts to be all inhabitants of France, the penſionaries and eleves all to reſide at Paris.

In the year 1716, the duke of Orleans, then regent, made an alteration in their conſtitution, augmenting the number of honoraries and aſſociates to twelve, admitting regulars among ſuch aſſociates, ſuppreſſing the claſs of eleves, and eſtabliſhing in lieu thereof a new claſs of twelve adjuncts to the ſix ſeveral kinds of ſcience cultivated by the academy; and, laſtly, appointing a vice-preſident, to be choſen yearly by the king out of the honorary members, and a director and ſub-director out of the penſionaries.

The academies of Florence and Bologne, of Montpelier and Bourdeaux, of Leipſic and Berlin, and of late thoſe of Peterſburg and Seville, were formed upon the ſame model with the Royal Academy of Sciences.

French ACADEMY, a ſociety of forty, eſtabliſhed for improving the French language.

This academy was founded by Cardinal Richlieu, and confirmed by the edict of Lewis XIII. in 1635. They have compiled a dictionary, intitled, *Le Dictionaire de l'academie Francoiſe*. This work was begun in 1637, and finiſhed in 1694. They have a director and chancellor, who are drawn by lot every three months, and a ſecretary who is perpetual. They meet at the old Louvre, on the Mondays, Thurſdays, and Saturdays, all the year round, and hold an extraordinary meeting at the reception of a new member, and on St Lewis's day, when the prizes of eloquence and poetry are adjudged.

Royal ACADEMY *of Painting and Sculpture*. This ſociety was founded about the year 1648. The members were at firſt about twenty-five in number, *viz.* twelve officers, called *ancients*, eleven private members, and two ſyndics; but at preſent it conſiſts of forty painters and ſculptors. There are four perpetual rectors, nominated by the king; a director and chancellor; a ſecretary, who keeps the regiſter, and counterſigns the diſpatches; a treaſurer, twelve profeſſors, adjuncts to the rectors and profeſſors, ſix counſellors, a profeſſor for the part of anatomy that belongs to painting and ſculpture, and another for geometry and perſpective.

There is alſo an academy of painting, ſculpture, *&c.* at Rome, eſtabliſhed by Lewis XIV. wherein thoſe who have won the annual prize at Paris, are entitled to be three years entertained for their further improvement.

ACADEMY *of Medals and Inſcriptions*, called alſo *The academy of belles lettres*, was erected by Lewis XIV. for the ſtudy and explanation of ancient monuments, and to perpetuate the remembrance of great events, by medals, relievos, inſcriptions, *&c.* The plan of this academy was formed by Mr Colbert, and eſtabliſhed in 1663. In its firſt inſtitution it conſiſted only of four or five members; but in 1701, they were increaſed to forty, *viz.* ten honoraries, ten penſionaries, ten aſſociates, and ten novices or eleves, under the direction of a preſident and vice-preſident, who are annually appointed by the king.

Their chief employment has been upon the medallic hiſtory of the reign of Lewis their founder. But the learned are indebted to this academy for many volumes of eſſays on other parts of hiſtory, publiſhed under the title of *Memoirs*, &c.

ACADEMY *of Architecture*, eſtabliſhed about the end of the year 1671 by Mr Colbert, conſiſted at firſt only of ſix architects; but their number is ſince conſiderably increaſed.

ACADEMY *of Politics*, is compoſed of ſix perſons, who meet at the Louvre, in the chamber where the papers relating to foreign affairs are lodged. But as the kings of France are unwilling to truſt any, except their miniſters, with the inſpection of foreign affairs, this academy is of little uſe to the public.

Royal ACADEMY *of Dancing* was eſtabliſhed by the King of France in 1661. It conſiſts of thirteen able dancing-maſters,

maſters, who meet once a-month; and two of the academiſts teach by turns the art of dancing, ancient and modern.

The French have alſo academies in moſt of their great cities, as, the Academy of Sciences at Montpelier, that of the Lanterniſts at Thoulouſe; beſides others at Niſmes, Arles, Angiers, Lyons, Caen in Normandy, *&c.*; and the Chirurgical Academy at Paris is a modern inſtitution for the general improvement of the art, and to compile and publiſh the ancient and modern hiſtory of it.

Royal Spaniſh ACADEMY at Madrid, has for its object the cultivation of the Caſtilian tongue, and was eſtabliſhed in 1714 by the Duke d'Eſcalona, with the approbation of the King of Spain. It conſiſts of twenty-four academiſts, including the director and ſecretary.

In Portugal, John V. founded an hiſtorical academy at Liſbon, in the year 1720, for collecting and aſcertaining the hiſtory of his own dominions. It conſiſts of fifty members, a director, four cenſors, and a ſecretary.

In Germany, they have the Academy of *Naturæ Curioſi*, otherwiſe called the *Leopoldine Academy*, founded in 1652 by Jo. Laur. Bauſch a phyſician, and, in 1670, taken under the protection of the Emperor Leopold. The deſign of this ſociety was to promote medical knowledge. They began in 1684 to publiſh their obſervations, under the title of *Ephemerides*; which publication has been continued annually, with ſome interruptions, and under different titles. This academy conſiſts of a preſident, two adjuncts or ſecretaries, and colleagues or members without limitation.

Berlin ACADEMY, was founded by Frederick I. the late King of Pruſſia, in the year 1700. It has for its objects the improvement of natural knowledge, and the belles lettres. The charter of this ſociety was amended in 1710, and by it the preſident is to be nominated by the king. The members are divided into four claſſes; 1. for phyſic, medicine, and chemiſtry; 2. for mathematics, aſtronomy, and mechanics; 3. for the German language, and the hiſtory of the country; 4. for Oriental learning, particularly what relates to the propagation of the goſpel among infidels. The great promoter of this foundation was the celebrated Mr Leibnitz.

Ruſſian ACADEMY was founded by Czar Peter the Great, at Peterſburg, upon the plan of the Academy of Sciences at Paris; beſides which, they take in the Ruſſian language.

ACADEMY is alſo a term for ſchools and other ſeminaries of learning among the Jews, where their rabbins and doctors inſtructed their youth in the Hebrew language, and explained to them the Talmud, and the ſecrets of the Cabbala: Thoſe of Tiberias and Babylon have been the moſt noted.

ACADEMY is often uſed with us to denote a kind of collegiate ſchool, where youth are inſtructed in arts and ſciences. There is one at Portſmouth for teaching navigation, drawing, *&c.*; another at Woolwich, for fortification, gunnery, *&c.*

ACADEMY is likewiſe a name given to a riding-ſchool, where young gentlemen are taught to ride the great horſe, *&c.* and the ground allotted for it is uſually called the *Menage*.

ACADEMY *figure*, a drawing of a naked man or woman, taken from the life, which is uſually done on paper with red or black chalk, and ſometimes with paſtils or crayons.

ACADIE, or ACADIA, in geography, a name formerly given to Nova Scotia, one of our American colonies. See NOVA SCOTIA.

ACÆNA, in antiquity, a Grecian meaſure of length, being a ten feet rod, uſed in meaſuring their lands.

ACAIABA. See ACAJOU.

ACAJA, in botany, a ſynonime of the ſpondias lutea, an American tree. See SPONDIAS.

ACAJOU, in botany, a ſynonime of the anacardium occidentale, or caſhew-nut-tree. See ANACARDIUM.

ACALEPTIC, in ancient proſody, a complete verſe.

ACALIS, in botany, an obſolete name of the Ceratonia. See CERATONIA.

ACALYPHA, in botany, a genus of plants belonging to the monœcia monadelphia claſs. There are only four ſpecies of this plant; the acalypha virginica, which is a native of Ceylon; the virgata, indica, and auſtralis, all natives of America. Sir Hans Sloane ranks this plant with the nettle, under the name of *urtica minor iners ſpicata*.

ACAMATOS, a word uſed to expreſs the beſt ſhape of the human body.

ACAMBOU, a kingdom on the coaſt of Guinea in Africa.

ACAMEEH, among ſome of the old chemiſts, the ſcoriæ of ſilver; as alſo a ſuperfluity of the humidum radicale.

ACANACEOUS *plants*, ſuch as are armed with prickles.

ACANAPHORA, in botany, an obſolete name of the centaurea jacea, or knapweed. See CENTAUREA.

ACANES, in geography. See AKANIS.

ACANGIS, that is, *ravagers* or *adventurers*; a name which the Turks give their huſſars or light-troops, who are generally ſent out in detachments to procure intelligence, haraſs the enemy, or ravage the country.

ACANNY, an inland country on the gold coaſt of Guinea in Africa, which affords the beſt gold, and in great plenty. There is a town or village of the ſame name, W. long. 0. 5. lat. 8. 30.

ACANTHA, in botany, the prickle of any plant.

ACANTHA, in zoology, a term for the ſpine or prickly fins of fiſhes.

ACANTHA, in anatomy, an obſolete term for the ſpinal proceſſes of the back.

ACANTHABOLUS, in ſurgery, an inſtrument for pulling thorns, or the like, out of the ſkin.

ACANTHACEOUS, among ancient botaniſts, an epithet given to thiſtles and other prickly plants.

ACANTHE, in botany, an obſolete name for the Cynara or artichoak. See CYNARA.

ACANTHIAS, in ichthyology, the trivial name of a ſpecies of ſqualus. See SQUALUS.

ACAN-

ACANTHINE, any thing resembling or belonging to the herb acanthus. Acanthine garments, among the ancients, are said to be made of the down of thistles; others think they were garments embroidered in imitation of the acanthus.

ACANTHIUM, in botany, the trivial name of a species of onopordum. See ONOPORDUM.

ACANTHOIDES, in botany, a synonimie of the carlina, or carline-thistle. See CARLINA.

ACANTHOPTERYGIOUS *fishes*, a term used by Linnæus and others for those fishes whose back-fins are hard, osseous, and prickly.

ACANTHUS, bears-breach, or brank-ursine, in botany, a genus of plants belonging to the didynamia angiospermia class. There are only five species of this plant, all of which are natives either of Italy or the Indies. For its figure, which is extremely beautiful, see plate I. fig. 3. The leaves of the acanthus are famous for having given rise to the capital of the Corinthian order of architecture.

ACANTHUS is likewise used by Theophrastus as a synonime of the acacia.

ACANTHUS, in architecture, an ornament representing the leaves of the acanthus, used in the capitals of the Corinthian and Composite orders. See ARCHITECTURE.

ACANUS, in botany, a synonime of the carduus casabonæ of Linnæus. See CARDUUS.

ACAPATLI, the American name of the piper longum, or long pepper. See PIPER.

ACAPNON, in botany, an obsolete name of the origanum or marjoram. See ORIGANUM.

ACAPULCO, in geography, a sea-port town in North America, in 102. 0. W. long. 17. 3. N. lat. situated in the province of Mexico, on a fine bay of the South-sea, from whence a ship sails annually to Manilla in the Philippine islands.

ACARA, in ichthyology, an obsolete name of the perca chrysoptera. See PERCA.

ACARA-AYA, in ichthyology, an obsolete name of a species of the cyprinus or carp. See CYPRINUS.

ACARA-PEBA, in ichthyology, an obsolete name of the sparus. See SPARUS.

ACARA-PINIMA, in ichthyology, an obsolete name of the sparus cantharus. See SPARUS.

ACARA-PITAMBA, in ichthyology, an obsolete name of a species of the mugil. See MUGIL.

ACARAI, a town in Paraguay in South America, built by the Jesuits in 1624, 116. 40. long. 26. 0. S. lat.

ACARI. See ACARUS.

ACARICOBA, in botany, a synonime of the hydrocotyle umbellata. See HYDROCOTYLE.

ACARNA, in botany, a synonime of the carduus causabonæ, of the cnicus, of the carlina lanata, corymbosa, racemosa, and cancellata. Acarna is also used by Vaillant as a term for cynaracephalous or artichoak-headed plants.

ACARNAN, an obsolete name of the sparus erythrynus. See SPARUS.

ACARON, the name of the god of flies. The Ekronites called him *Baalzebub*.

ACARUS, a genus of insects belonging to the order of aptera, or such as have no wings. The acarus has 8 legs, 2 eyes, one on each side of the head, and two jointed tentacula like feet. See plate I. fig. 4. There are thirty-one species of the acarus. 1. The elephantinus, is about the size of a white lupin seed, has a depressed orbicular livid body, thickest at the edges, with three furrows on each side of the belly, and a black oval trifid spot at the base or end of the body. It is a native of India. 2. The ægyptius, is of an oval shape, yellowish colour, and a white edge or margin. It is a native of the East. 3. The reduvius is plain and oval, with an oval spot at the base. It lives on oxen and dogs. 4. The americanus, is reddish and oval, with the scutellum and joints of the feet white. It is a native of America. 4. The sanguisugus. The hinder part of the abdomen is crenated, the scutellum is oval and yellowish, and the beak is trifid. It is a native of America, and sticks so fast on the legs of travellers, sucking their blood, that they can hardly be extracted. 6. The ricinus is globular, and has a round spot at the base; the feelers are clubbed. It inhabits the bodies of dogs and oxen. 7. The cancroides, with nippers like a crab, and an oval depressed belly. It is found in the shady places of Europe. 8. The scorpioides, with crab-like nippers, a cylindrical belly, and a small pendulous head. It is of a yellowish colour; and its bite is venomous. It is a native of America. 9. The crassipes has the second pair of legs shaped like those of a crab, and is a native of Europe. 10. The passerinus has the third pair of legs remarkably thicker than the rest. It infests several species of sparrows. 11. The motatorius has the first pair of legs very long and nimble, and frequents the woods. 12. The aphidioides has the first pair of feet longest, and two small horns at the hinder part of the belly. It is a native of Europe. 13. The coleoptratus is black, and the sides are a little crustaceous. It is a native of Europe. 14. The telarius is of a greenish yellow colour. It has a small sting or weapon, with which it wounds the leaves of plants, and occasions them to fold backward. They are very frequently to be met with in the autumn, inclosed in the folded leaves of the lime-tree. 15. The siro has lob-like sides; the four hinder feet are longest; the head and thighs are of an iron colour, and the belly is bristly. It inhabits the farinaceous plants of Europe and America. 16. The exulcerans has very long setaceous legs, but the two first are short. It inhabits the scabies. 17. The geniculatus, is black, and the joints of the thighs are globular. 18. The aquaticus has a depressed red belly, and the hinder part of it obtuse. It inhabits the fresh waters of Europe. 19. The holosericeus has the same characters with the former, only it does not live in water. 20. The baccarum, has a red distended belly, and lives on gooseberries, &c. 21. The muscorum, is of a yellowish red colour, and the hinder legs are long and threed-like. It inhabits mosses. 22. The batatas, is of a blood-colour, and a little rough; the fore pair of legs are as long as the body.

body. It inhabits the potatoes of Surinam. 23. The gymnopterorum, is reddiſh, with two ſcarlet ſpots on each ſide. It inhabits bees, *&c.* 24. The coleoptratorum, is reddiſh, with a white anus. It inhabits the ſcarabæus. 25. The rupeſtris, is yellowiſh, with a double coloured line on the back. It is a native of Europe. 26. The longicornis, is red, and the feelers are longer than the ſnout. It is a native of Europe. 27. The littoralis, is of a tawny yellowiſh colour, and has blood-red legs. It frequents the ſhores of Europe. 28. The fungorum is of a yellowiſh colour, and has a globular clammy belly. It inhabits the muſhroom. 29. The ſcaber, is aſh-coloured, and depreſſed; the ſides are ſcurfy. It is a native of Europe. 30. The ſalicinus, is red, with two yellow lines on the back; it is forked before. It dwells on the willows. 31. The croceus, is yellow, with a reddiſh ſpot on each ſide of the breaſt.

ACATALECTIC, a term, in the ancient poetry, for ſuch verſes as have all their feet or ſyllables, in contradiſtinction to thoſe that have a ſyllable too few.

ACATALEPSY, ſignifies the impoſſibility of comprehending any thing.

ACATALIS, a name given by the ancients to the juniper-berry.

ACATASTATOS, with phyſicians, ſignifies the irregular paroxyſms of a diſeaſe.

ACATERY, or ACCATRY, an officer of the king's houſehold, deſigned for a check betwixt the clerks of the kitchen and the purveyors.

ACATHARSIA, an impurity of the blood or humours.

ACATHISTUS, in an eccleſiaſtical ſenſe, a ſolemn hymn anciently ſung in the Greek church on the Saturday of the fifth week of Lent, in honour of the Virgin, for having thrice delivered Conſtantinople from the invaſions of the barbarous nations.

ACATIUM, in antiquity, a kind of boat uſed in military affairs, and was a ſpecies of the naves actuariæ. See ACTUARIÆ NAVES.

ACATSIA-VALLI, in botany, a ſynonime of the caſſitha filiformis. See CASSITHA.

ACAULIS, in botany, ſignifies plants that have no caulis or ſtem.

ACCALIA, in antiquity, ſolemn feaſts held in honour of Acca Laurentia, nurſe to Romulus. They were otherwiſe called *Laurentalia.*——To the ſame Acca is alſo aſcribed the inſtitution of the *fratres arvales.*

ACCAPITARE, in law, the act of becoming vaſſal of a lord, or of yielding him homage and obedience. See VASSAL and HOMAGE.

ACCAPITUM, ſignifies the money paid by a vaſſal upon his admiſſion to a feud.

ACCAPITUM, in our ancient law, was uſed alſo to expreſs the relief due to the chief lord. See RELIEF.

ACCEDAS *ad curiam,* in the Engliſh law, a writ lying, where a man has received, or fears falſe judgment, in an inferior court; it lies alſo for juſtice delayed, and is a ſpecies of the writ *recordare.*

ACCEDONES. See ACCENDONES.

ACCELERATED, implies, in a general ſenſe, quickened, continually increaſing. Thus, *accelerated motion* is a motion continually increaſing. See MECHANICS.

ACCELERATION, an increaſe of velocity in the motion of a body; it is oppoſed to retardation, which is a diminution of motion.

ACCELERATION, is alſo a term uſed by ancient aſtronomers, with whom it ſignified the difference between the revolution of the primum mobile, and that of the ſun, computed to be three minutes and fifty-ſix ſeconds.

ACCELERATOR, in anatomy, the name of two muſcles of the penis, which ſerve for ejecting the urine or ſemen. See ANATOMY, Part VI.

ACCENDENTES, a lower order of miniſters in the Romiſh church, whoſe office is to light and trim the candles.

ACCENDONES, in Roman antiquity, a ſort of gladiators, whoſe office was to excite and animate the combatants during the engagement. See GLADIATOR.

ACCENSI, among the ancient Romans, a kind of ſupernumerary ſoldiers, who ſerved to fill the places of thoſe who were killed or diſabled by their wounds.

ACCENSI *ferenſes,* among the Romans, an inferior order of officers, who attended the magiſtrates in the manner of our uſhers, ſerjeants, or tipſtaffs.

ACCENSION, in chemiſtry, the action of ſetting a body on fire: thus the accenſion of tinder is effected by ſtriking fire with flint and ſteel.

ACCENT, or accenting, in reading or ſpeaking: When we raiſe the tone higher in ſounding any particular word or ſyllable, that word or ſyllable is ſaid to be accented, or graced with an accent. In hexameters there is a capital accent in every line, eaſily diſtinguiſhable from the reſt by a good ear. Thus,

Nec bene promeritis capitûr, nec tangitur ira.

Accents either in proſe or poetry have a double effect: They contribute to the melody, by giving it air and ſpirit; they contribute not leſs to the ſenſe, by diſtinguiſhing words of importance from others. Accenting is entirely confined to long ſyllables; for a ſhort ſyllable is not capable of an accent. Every word in an hexameter line that has a long ſyllable may be accented, unleſs the ſenſe interpoſe, which rejects the accenting a word that makes no figure by its ſignification. But, notwithſtanding this circumſtance, there is conſtantly one accent in every line which makes a greater figure than any of the reſt. Thus,

Smooth flow the wâves, the zephyrs gently play,
Belinda ſmil'd, and all the world was gay.

In order to facilitate the reading of dead languages, grammarians have adopted various characters for diſtinguiſhing the accents belonging to particular ſyllables; ſuch as the acute, marked thus, (ˊ), the grave thus (ˋ), and the circumflex thus (˘), or (ˆ), *&c.* The acute denotes that the voice is to be raiſed; the grave, that it is to be lowered or flattened; and the circumflex, that the ſyllable is to be lengthened or dwelt upon.

ACCENT, in music, is a certain modulation of sounds to express a passion, whether by the voice or instruments. See MUSIC.

ACCENTER, in music, one of the three singers in a trio, *viz.* the person who sings the highest part. See TRIO.

ACCEPTANCE, in Scots law, denotes either a person's adhibiting his subscription to a bill or draught, by which he subjects himself to the payment of it; or accepting or agreeing to offers made in bargaining, by which the bargain is concluded.

ACCEPTANCE, in the church of Rome, is put for receiving the Pope's constitutions.

ACCEPTANCE, in commerce, is the subscribing, signing, and making one's self debtor for the sum contained in a bill of exchange, or other obligation. See BILLS.

ACCEPTATION, in grammar, the sense or meaning wherein any word is taken.

ACCEPTER, or ACCEPTOR, the person who accepts a bill of exchange, *&c.*

ACCEPTION, the same with acceptation.

ACCEPTILATION, among civilians, an acquittance or discharge given by the creditor to the debtor without the payment of any value.

ACCESS, the approach of one person or thing to another. It is also used by physicians for the beginning of a paroxism.

ACCESSARY, or ACCESSORY, in law. See ACCESSORY.

ACCESSIBLE, something that may be approached, or that access may be had to. Thus we say, Such a place is accessible on one side, *&c.*

ACCESSION, in Scots law, is a method of acquiring property, by which, in things that have a close connexion or dependence upon one another, the property of the principal thing draws after it the property of the accessory. Thus, the owner of a cow becomes likewise the owner of the calf. See LAW, title, *Division of rights.* It sometimes likewise signifies consent or acquiescence.

ACCESSION, among physicians, is used for a paroxysm of a disease; among politicians, it signifies a prince's succeeding to the government upon the death of his predecessor.

ACCESSORY, in Scots law, is the subject acquired by accession; or, in crimes, it signifies the person by whose assistance, advice, or command, the crime was committed: In this latter sense, it is the same with accomplice, art and part, *&c.* See LAW, title, *Crimes.*

ACCESSORY *nerve.* See ANATOMY, Part V.

ACCIB, a name given by some authors to lead.

ACCIDENT, in a general sense, denotes any casual event.

ACCIDENT, in logic, signifies secondary qualities, or such as do not essentially belong to any subject.

ACCIDENT, in grammar. See GRAMMAR.

ACCIDENT, in heraldry, an additional point or mark in a coat of arms, which may be either omitted or retained without altering the essence of the armour; such as, *abatements*, *differences*, and *tincture.*

ACCIDENT, among physicians, an obsolete term for a symptom.

ACCIDENTS, in astrology, the most remarkable occurrences in a man's life.

Absolute ACCIDENT, in the Romish church, an accident which may possibly subsist, at least miraculously, without a subject; which is unintelligible jargon.

ACCIDENTAL, something that happens by accident, or a mode that is not essential to its subject.

ACCIDENTAL *point*, in perspective. See PERSPECTIVE.

ACCIDENTAL *dignities* and *debilities*, in astrology, certain casual dispositions of the planets, whereby they are supposed to be either strengthened or weakened.

ACCIPENSER, in ichthyology, a genus of fishes belonging to the Amphibia Nantes of Linnæus. The accipenser has a single linear nostril: the mouth is in the under part of the head, and contains no teeth; the cirri are below the snout, and before the mouth. There are four species of this genus, *viz.* 1. The sturio, or sturgeon, with 4 cirri, and 11 squamous protuberances on the back. It inhabits the European seas. This fish was so greatly esteemed in the time of Severus, that he ordered it to be carried to his feasts by servants crowned with garlands, and trumpets playing before. See Plate I. fig. 5. 2. The ruthenus has 4 cirri, and 15 squamous protuberances. It is a native of Russia. 3. The huso has 4 cirri; the body is naked, *i. e.* has no prickles or protuberances. The skin of the huso is so tough and strong, that it is employed for ropes in carts and other wheel-carriages. Isinglass is also made of the skin of this fish, and its eggs are sometimes made into pickles. It inhabits the Danube, and the rivers of Russia. See Plate I. fig. 6. 4. The plecostomus, which is distinguished from the other three by having only 2 cirri. It is a native of Surinam. The whole four species are viviparous.

ACCIPENSIUS. See ACCIPENSER.

ACCIPITER, the name of Linnæus's first order of birds. The birds belonging to this order have crooked beaks. This order comprehends only four genera, *viz.* The vultur, falco, strix, and lanius. See VULTUR, *&c.*

ACCIPITRINA; an obsolete name of the hierachium or hawkweed. See HIERACHIUM.

ACCISMUS, in antiquity, signifies a feigned refusal of what one earnestly desires.

ACCISMUS, in rhetoric, is accounted a species of irony. See IRONY.

ACCLAMATION, any expression of joy, or applause, whereby the public testifies its approbation.

ACCLAMATION is also used, in a bad sense, for expressions of detestation.

ACCLAMATION, in rhetoric, a figure, the same with EPIPHONEMA, which see.

ACCLAMATION *medals*, among antiquaries, such as represent the people expressing their joy in the posture of acclamation.

ACCLIVUS, in anatomy, a synonime of the obliquus ascendens muscle. See ANATOMY, Part II.

ACCLIVITY, the rise or ascent of a hill, in opposition to the declivity or descent of it. Some writers

ters in fortification use it for the *talus* of a rampart.

ACCLOYED, in farriery, signifies pricked. Thus a horse's foot pricked in shoeing, is said to be *accloyed.*

ACCOLA, among the Romans, signified that a person lived near some place.

ACCOLADE, in antiquity, one of the forms of conferring knighthood, in which the prince laid his arms about the neck of the young knight, embraced him, and, some say, gave him a blow on the cheek, neck, or shoulder, in imitation of the form of manumission among the Romans.

ACCOLEE, sometimes synonomous with ACCOLADE, which see. — It is also used in divers senses in heraldry: Sometimes it is applied to two things joined; at other times, to animals with crowns, or collars about their necks, as the lion in the Ogilvy's arms; and lastly to kews, battons, maces, swords, &c. placed saltier-wise behind the shield.

ACCOMMODATION, making two or more things agree with one another.—Among divines, it is applying what is originally said of one person, or thing, to another: Thus the words of Isaiah to the Jews of his time, are, by our Saviour, accommodated to his contempories, and by St Paul to his.—In law, it signifies the amicable issue of a debate, which is effected sometimes by mediation of friends, sometimes by submission, and sometimes by a division of the subject in debate.

ACCOMPAGNAGE, a term in the silk manufactures, signifying a fine woof of the same colour with the gilding, helping to enrich the ground under which it passes, and to hinder it from striking cross the gilding itself, which would diminish its gloss and lustre. All rich stuffs, the warps whereof are of a colour different from the gilding, should be accompanied.

ACCOMPANIMENT, something attending or added as a circumstance to another, either by way of ornament, or for the sake of symmetry. See CIRCUMSTANCE.

ACCOMPANIMENT, in music, these parts that are added to render the harmony more full and complete, as an instrument accompanying a voice. Among the moderns, the accompaniment frequently plays a different melody from the song it accompanies; but authors are not agreed whether it was so among the ancients. See MUSIC.

ACCOMPANIMENT, in painting, denotes such objects as are added, either by way of ornament, or probability, as dogs, guns, game, &c. in a hunting piece. See PAINTING.

ACCOMPANIMENT, in heraldry, any thing added to a shield by way of ornament; as the belt, mantling, supporters, &c. It is also applied to several bearings about a principal one; as a saltier, bend, fess, chevron, &c.

ACCOMPLICE, in law. See ACCESSORY.

ACCOMPLISHMENT, the entire execution or fulfilling of any thing.

ACCOMPLISHMENT, is also used for any mental or personal endowment.

ACCOMPT. See ACCOUNT.

ACCOMPTANT. See ACCOUNTANT.

ACCORD, in music. See CONCORD.

ACCORD, in law, an accommodation between parties at variance, by means of an offer made by the one, and accepted by the other.

ACCORD, in painting, is the harmony that reigns among the lights and shades of a picture.

ACCORNED, in heraldry: When any figure of an animal, in an escutcheon, has horns of a different colour from those of the real animal, then it is said to be *accorned.*

ACCOUNT, or ACCOMPT, in a general sense, a computation or reckoning of any thing by numbers. Collectively, it is used to express the books which merchants, traders, bankers, &c. use for recording their transactions in business. See BOOK-KEEPING.

ACCOUNT *in company*, is an account betwixt partners relating to the transactions of their joint concern. See BOOK-KEEPING.

ACCOUNT *of sales*, is an account given by one merchant to another, or by a factor to his principal, of the disposal, charges, commission, and nett proceeds of certain merchandises sent for the proper or company account of him that consigned them to such factor or vender. See BOOK-KEEPING.

ACCOUNT *current,—of goods*. See BOOK-KEEPING.

ACCOUNT *in bank*, a fund which it is common for merchants or others to furnish themselves with in the cash of a bank, to be in readiness for the payment of bills of exchange, purchases, &c.

Auditing an ACCOUNT, is the examining and passing an account by an officer appointed for the purpose. See AUDITOR.

Chamber of ACCOUNTS, in the French polity, is a sovereign court of great antiquity, which takes cognizance of, and registers the accounts of the king's revenue. It is nearly the same with the English *Court of* EXCHEQUER; which see.

ACCOUNT *in the remembrancer's office*, in the exchequer, is the state of any branch of the king's revenue; as the account of the mint, of the wardrobe, of the army, navy, &c.

ACCOUNT, in law, the action that lies against a person who is accountable by office to another, but refuses to render the account.

ACCOUNT, is also taken sometimes, in a particular sense, for the computation of time; as we say, The Julian account, the Gregorian account, &c. in which sense it is equivalent to *style*.

ACCOUNT is also used in sundry mercantile forms of expression for advantage, hazard, loss, &c.

ACCOUNTABLE, a term used to denote a person's being liable to render an account for any thing.

ACCOUNTANT, or ACCOMPTANT, in the most general sense, is a person skilled in accounts. In a more restricted sense, it is applied to a person, or officer, appointed to keep the accounts of a public company, or office, as the South-sea, the India company, the bank, the excise, &c.

ACCOUNTANTSHIP, the art of keeping and balancing accounts. See BOOK-KEEPING.

ACCOUNT-

ACCOUNTANT-GENERAL, a new officer in the court of Chancery appointed by act of parliament to receive all monies lodged in court instead of the masters, and convey the same to the bank of England for security.

ACCOUNTING-HOUSE, counting-house, or compting-house, is a house, or office, set apart by a merchant, or trading-company, for transacting their business, as well as keeping their books, accounts, vouchers, *&c.*

ACCOUTREMENT, an old term, applied to the furniture of a soldier, knight, or gentleman.

ACCRETION, in physics, the increase, or growth, of an organical body, by the accession of new parts.

ACCRETION, among civilians, the property acquired in a vague or unoccupied thing, by its adhering to or following another already occupied; thus, if a legacy be left to two persons, one of whom dies before the testator, the legacy devolves to the survivor by right of accretion.

ACCROCHE, in heraldry, denotes a thing's being hooked with another.

ACCROCHING, in old law-books, is incroaching upon, or usurping another man's right.

ACCRUE, in law, any thing that is connected to another as an appendage.

ACCUBATION, in antiquity, the posture used by the Greeks and Romans at table. The body was extended, and the head resting on a pillow, or on the elbow.

The Romans at their meals made use of a low round table, around which two or three couches were placed in proportion to the number of guests; and hence it was called *biclinium*, or *triclinium*. These were covered with a sort of bed-cloaths, and furnished with quilts and pillows for leaning on. The guests reclined on the left side, the first at the head of the bed, with his feet behind the back of the second, *&c.* Before they came to table, they changed their cloaths, for what they called the *cœnatoria vestes*, the dining garment, and pulled off their shoes to keep the couch clean.

ACCUBITOR, an ancient officer of the emperors of Constantinople, whose business was to lie near the emperor. He was the head of the youths of the bed-chamber, and had the *cubicularius* and *procubitor* under him.

ACCUMULATION, in a general sense, the act of heaping or amassing things together. Among lawyers it is used in speaking of the concurrence of several titles to the same thing, or of several circumstances to the same proof.

ACCUMULATION *of degrees*, in an university, is the taking several of them together, or at smaller intervals than usual, or than is allowed by the rules of the university.

ACCURATE. See EXACTNESS.

ACCURSED, denotes something that lies under a curse, or is detestable. It is likewise used for an excommunicated person.

ACCUSATION, in law, the charging any person with a criminal action, either in one's own name, or that of the public. It differs little from impeachment or indictment.

ACCUSATIVE. See GRAMMAR.

AC-DENGHIS, a name given to the Archipelago by the Turks.

ACE, a term among gamesters, signifying a card or die marked with a single point.

ACENTETUM, or ACENTETA, names used by the ancients for the purest rock crystal. See CRYSTAL.

ACEPHALI, or ACEPHALITÆ, a name given, in ecclesiastical history, to several sects that were destitute of any head or leader; as also, to such bishops as were exempted from the jurisdiction of a patriarch.

ACEPHALOUS, in our ancient law-books, an appellation given to such persons as held nothing of any superior.

ACEPHALUS, without a head.

ACEPHALUS, an obsolete term for the tenia, or tape-worm. See TENIA.

ACEPHALUS, is also used to express a verse defective in the beginning.

ACER, in botany, the maple or sycomore tree, a genus of the polygamia diœcia class. There are ten species of this genus. The calix of the female is quinquifide, the corolla pentapetalous, the stamina eight, one pistil, and two seed-capsules. The calix of the male is also quinquifide, the corolla pentapetalous, and the stamina eight. There are only two species of the acer which are reckoned natives of England, *viz.* the pseudo-platanus, and the campestre.

ACERB, a sour rough astringency of taste, such as that of unripe fruit. See ASTRINGENT.

ACERENZA. See CIRENZA.

ACERIDES, signifies a plaster without any wax in its composition.

ACERINA, an absolete name of a species of the perch, a fish of the thoracic order. See PERCA.

ACERNO, a town of Italy, in the kingdom of Naples, with a bishop's see. It is 17 miles S. W. of Conza, and 12 N. E. of Salerno, long. 14. 23. lat 40. 55.

ACERRA, in antiquity, an altar erected, among the Romans, near the gate of a person deceased, on which his friends daily offered incense, till his burial.—The Chinese have still a custom like this; they erect an altar to the deceased in a room hung with mourning, and place an image of the dead person on the altar, to which every one that approaches it bows four times, and offers oblations and perfumes.

ACERRA, in geography, a town of Italy in the kingdom of Naples, and in the terra di Lavoro. It stands on the river Agno, 7 miles N. E. of Naples, and 20 S. W. of Benevento, lon. 14. 23. lat. 40. 55.

ACERRÆ, the pots wherein incense was burnt.

ACERSECOMES, long-haired, a name of Apollo, because he was usually painted so.

ACESTIDES, in foundery, a name given by the ancients to the chimneys of their furnaces wherein brass was made.

ACETABULUM, in antiquity, a little vase or cup used at table to serve up sauces or seasoning. It also denotes

Plate I.

Fig. 1. Abacus

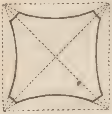


Fig. 2. Abacus or Counting Board

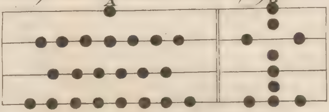
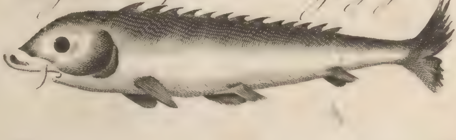


Fig. 3. Acanthus

Fig. 4. Acarus

Fig. 5. Accipenser sturio or Sturgeon

Fig. 6. Accipenser huso or Isinglass Fish



A. Bell Sculpt.


Fig. 1. ACHILLEA NOBILIS or
purple Tansy leav'd Yarrow.
Fig. 2.
ACONITUM PYRENAICUM
or
Yellow Pyrenean Aconite

J. Bell Sculp.

notes a Roman meaſure, both for liquid and dry things, equal to a cyathus and a half.

ACETABULUM, in anatomy, a cavity in any bone for receiving the protuberant head of another, and thereby forming that ſpecies of articulation called *enarthroſis*. See ANATOMY, Part I.

ACETABULUM, in botany, the trivial name of a ſpecies of the peziza, or cup-peziza, a fungus belonging to the cryptogamia fungi of Linnæus. It has got the name of *acetabulum* from the reſemblance its leaves bear to a cup. See PEZIZA.

ACETARY. Nehemiah Grew, in his anatomy of plants, applies this term to a pulpy ſubſtance in certain fruits, *e. g.* the pear, which is incloſed in a congeries of ſmall calculous bodies towards the baſe of the fruit, and is always of an acid taſte. See AGRICULTURE, Sect. 1.

ACETIFICATION, a term uſed by chemiſts for the making of vinegar.

ACETOSA, in botany, a ſynonime of the rumex, or ſorrel. See RUMEX.

ACETOSE, or ACETOUS, an epithet applied to ſuch ſubſtances as are ſour, or partake of the nature of vinegar.

ACETUM, vinegar, the vegetable acid of the chemiſts. See CHEMISTRY, title, *Of acids*.

ACETUM *diſtillatum*, in chemiſtry, diſtilled vinegar.

ACETUM *eſuriens*, in chemiſtry, a diſtilled vinegar, rectified by the help of verdigreaſe.

ACETUM *radicatum*. Boerhaave thinks the *tartarus regeneratus* is the *acetum radicatum* of the old chemiſts.

ACGIAH-SARAI, a town on the north ſhore of the Caſpian ſea.

ACH, or ACHE, in medicine, a term uſed for any ſevere pain, as head-ach, tooth-ach, *&c.* See MEDICINE.

ACHAC, a barbarous name of a ſpecies of the tetrao, a bird of the order of gallinæ. See TETRAO.

ACHÆINUS. See ACHIENUS.

ACHAIA, a province of Turkey in Europe, now called *Livadia*, of which Athens was anciently the capital, at preſent named *Saithines* or *Setines*. See LIVADIA.

ACHALACTLI, in ornithology, a barbarous name of the columba cyanocephala. See COLUMBA.

ACHAM, a country in the E. Indies, bounded on the N. by Bouton, on the E. by China, on the S. by Ava, and on the W. by Patan and Jeſuat in Bengal. It is very little known to the Europeans.

ACHANE, in Perſian antiquity, a corn-meaſure, equal to forty-five Attic medimni. See MEDIMNI.

ACHANDES. See REMORA.

ACHAOVA, in botany, an obſolete name of the marum matricaria, *&c.* See MARUM.

ACHASSES, a river of Languedoc in France.

ACHAT, in the law-French, ſignifies a contract or bargain, eſpecially by way of purchaſe.

ACHAT. See AGAT.

ACHATOR, in the old law-books, is uſed for PURVEYOR, which ſee.

ACHBALUC-MANGI, a town in the northern confines of China.

ACHE, in medicine. See ACH.

ACHECAMBEY, one of the Bahama iſlands. See BAHAMA.

ACHELO, a town near the Euxine ſea.

ACHEN, or ACHEM, a capital town of a kingdom of the ſame name, in the N. part of the iſland of Sumatra, in the E. Indies. It extends as far as the line. The inhabitants are generally very ſuperſtitious. It has for a conſiderable time been a noted place for trade; and was formerly governed by a queen; but in 1700, a Said, or Preacher, found means to uſurp the government. Its principal produce is gold duſt, which is exceeding good. They puniſh theft very ſeverely; yet robbery and murder are very frequent among them. This town is ſeated by the ſide of a river, and the king's palace is in the middle of the town, and is well fortified. It is 450 miles N. W. of Malua, and 1000 S. E. of Fort St George, 95.55. E. long. 5. 30. lat.

ACHERNER, in aſtronomy, a ſtar of the firſt magnitude in the ſouthern extremity of the conſtellation Eridanus. See ERIDANUS, and ASTRONOMY.

ACHETA, an obſolete name of the gryllus or cricket. See GRYLLUS.

ACHIAR, a Malayan word, ſignifying a ſort of fruit or roots pickled with vinegar and ſpice. See BAMBOE.

ACHIENUS, a name given by the ancients to the cervus or ſtag. See CERVUS.

ACHILLÆA, in botany, a genus of plants belonging to the ſyngeneſia polygamia ſuperflua claſs. Of this genus there are 21 ſpecies, only two of which are natives of Britain, *viz.* the achillæa millefolium, or common yarrow, (ſee Plate II. fig. 1.) and the achillæa ptarmica, or ſneezewort.

ACHILLÆA, a name frequently given by the ancients to the gum called dragons blood. See DRACONS-BLOOD.

ACHILLEID, ACHILLEIS, a celebrated poem of Statius, in which that author propoſed to deliver the whole life and exploits of Achilles; but being prevented by death, he has only treated of the infancy and education of his hero.

Tendo ACHILLIS. See ANATOMY, Part II.

ACHIMENES, in botany, a ſynonime of the columnea ſcandens, a genus of the didynamia angioſpermia claſs. See COLUMNEA.

ACHIOTE. See ACHIOTTE.

ACHIOTL, a name given to the drug *achiotte*.

ACHIOTTE, an American drug, uſed in dying and in [illegible] chocolate. It is produced from the mitella [illegible]lla, a tree which grows in North America. Bet[illegible] the ſmall filaments or leaves of this tree, little grains of a vermilion colour are found, which the Indians make into cakes, and ſend in this form to Europe; it is ſuppoſed to promote urine.

ACHIROPOETOS, a name given, by ancient writers, to certain pictures of Chriſt and the Virgin ſuppoſed to have been miraculouſly made without hands.

ACHLAR, a river in America, called *Araxis* by the ancients.

ACHLIS. See MACHLIS.

ACHLYS, in medicine, a dimneſs of ſight, ariſing from any ſcar remaining after an ulcer in the cornea. It is alſo uſed for the diſorder called a *ſuffuſion of the uterus*.

ACHMETSCHET, a town of the peninſula of the Crimea, the reſidence of the ſultan Galga, who is eldeſt ſon of the Khan of Tartary, 51. 20. long. 45. 0. lat.

ACHONRY, a ſmall town of Ireland in the province of Connaught, and county of Sligo, ſeated on the river Shannon.

ACHOR, in medicine, ſmall ulcers on the face which diſcharge a viſcid humour. See MEDICINE.

ACHRAS, in botany, a genus of the hexandria monogynia claſs. It bears a fruit not unlike the pear. There are only three ſpecies of the achras, *viz.* the mimoſa, the ſapota, and the ſalicifolia, all natives of America.

ACHRONICAL, ACHRONYCAL, or ACRONYCHAL. See ACRONICAL.

ACHYR, a ſtrong town and caſtle of the Ukrain, ſubject to the Ruſſians ſince 1667. It ſtands on the river Uorſklo near the frontiers of Ruſſia, 127 miles W. of Kiow, 36. 0. long. 49. 32. lat.

ACHYRANTES, in botany, a genus of the pentandria monogynia claſs. There are ſeven ſpecies of the achyrantes, moſt of them natives of the Indies.

ACHYRANTHA, in botany, the trivial name of a ſpecies of the illecebrum. See ILLECEBRUM.

ACHYRONIA, in botany, an obſolete name of a genus of the diadelphia decandria claſs.

ACHYROPHORUS, in botany, a ſynonime of the ſeriola. See SERIOLA.

ACIA, a term in the Roman ſurgery, about the meaning of which phyſicians and commentators are greatly divided; ſome taking it for the needle, and others for the thread.

ACICULÆ, the ſmall ſpikes or prickles of the hedgehog, echinus marinus, *&c.*

ACIDS, ſubſtances which give a ſour, ſharp, or tart taſte. Among the chemiſts, the acid ſalts are diſtinguiſhed into the nitrous, vitriolic, muriatic, and vegetable. See CHEMISTRY, title, *Of acids*.

ACIDS, in the materia medica, are ſuch medicines as poſſeſs an acid quality; ſuch as vinegar, ſpirit of vitriol, *&c.* Theſe being powerful antiſeptics, are eſteemed good in all purtrid and malignant diſeaſes, and, by their cooling virtue, are no leſs efficacious in feveriſh and inflammatory caſes.

ACIDITY, that quality which renders bodies acid.

ACIDOTON, in botany, is both a ſynonime and the trivial name of a ſpecies of the adelia. See ADELIA.

ACIDULÆ, a term for water or any ſubſtance impregnated with an acid.

ACIDULATED, a name given to medicines that have an acid in their compoſition.

ACIERNO, a town in the Hither Principality, in the kingdom of Naples, with a biſhop's ſee. It is 15 miles E. of Salerno, 37. 0. E. long. 40. 52. lat.

ACINAIES, in antiquity, a kind of cutlaſs, or ſcimeter, in uſe among the Perſians.

ACINARIA, in botany, a ſynonime of the fucus acinarius, belonging to the cryptogamia algæ of Linnæus. See FUCUS.

ACINI, in botany, a ſynonime of the thymus alpinus. See THYMUS.

ACINIFORMIS *tunica*, in anatomy. See UVEA.

ACINODENDRION, in botany, the trivial name of a ſpecies of the melaſtoma. See MELASTOMA.

ACINODENDRUM, in botany, a ſynonime of two ſpecies of the melaſtoma.

ACINOIDES, in botany, the trivial name of a ſpecies of the ziziphora. See ZIZIPHORA.

ACINOS, in botany, a ſynonime of a ſpecies of the cunila. See CUNILA.

ACINUS, in botany, ſignifies grapes or berries growing in cluſters.

ACISONTHERA, in botany, both a ſynonime and the trivial name of a ſpecies of the rhexia. See RHEXIA.

ACITLI, in ornythology, the American name of the colymbus criſtatus, a bird of the order of anſeres. See COLYMBUS.

ACKNOWLEDGMENT, in a general ſenſe, is a perſon's owning or confeſſing a thing; but, more particularly, is the expreſſion of gratitude for a favour.

ACKNOWLEDGMENT-*money*, a certain ſum paid by tenants in ſeveral parts of England, on the death of their landlords, as an acknowledgment of their new lords.

ACLIDES, in Roman antiquity, a kind of miſſive weapon, with a thong affixed to it, whereby to draw it back. Moſt authors deſcribe it as a ſort of dart or javelin; but Scaliger makes it roundiſh or globular, with a ſlender wooden ſtem to poiſe it by.

ACLOWA, in botany, a barbarous name of a ſpecies of colutea. It is uſed by the natives of Guinea to cure the itch. See COLUTEA.

ACME, or ACKME, the top or height of any thing. It is uſually applied to the maturity of an animal juſt before it begins to decline; and phyſicians have uſed it to expreſs the utmoſt violence or criſis of a diſeaſe.

ACMELLA, in botany, the trivial name of a ſpecies of the verbeſina. See VERBESINA.

ACNIDA, in botany, a genus of the diœcia pentandria claſs. There is only one ſpecies of it, *viz.* the acnida canabina. It is a native of Virginia.

ACNUA, in Roman antiquity, ſignified a certain meaſure of land, near about the Engliſh rood, or fourth part of an acre. See ROOD.

ACOBA, a ſmall town of Portugal in the province of Eſtremadura.

ACOEMETÆ, or ACOEMETI, in church hiſtory, or men who lived without ſleep; a ſet of monks who chaunted the divine ſervice night and day in their places of worſhip. They divided themſelves into three bodies, who alternately ſucceeded one another, ſo that their churches were never ſilent. This practice they founded upon the precept, *Pray without ceaſing*. They flouriſhed in the eaſt about the middle of the fifth century. There are a kind of acœmeti ſtill ſubſiſting in the

Roman church, *viz.* the religious of the holy ſacrament, who keep up a perpetual adoration, ſome one or other of them praying before the holy ſacrament, day and night.

ACOLASTRE, a ſmall river of France in the Nivernois.

ACOLCHICHI, in ornythology, a barbarous name of the phœnicopterus, a bird of the order of grallæ. See PHOENICOPTERUS.

ACOLIN, an obſolete name of a ſpecies of the tetrao, of the order of gallinæ See TETRAO.

ACOLIN, in geography, a river of France which takes its riſe in the Bourbonnois.

ACOLUTHI, a term applied to perſons who were firm and ſteady in their opinions, and particularly to the ſtoics, who were remarkably tenacious of their reſolutions and principles.

In church-hiſtory, the term *acolythus*, or *acolythiſt*, is peculiarly applied to candidates for the miniſtry who continually attend the biſhops.

ACOLYTHIA, in the Greek church, denotes the office or order of divine ſervice; or the prayers, ceremonies, hymns, *&c.* whereof the Greek ſervice is compoſed.

ACOMA, a town of N. America, in New-Mexico, ſeated on a high mountain, with a ſtrong caſtle. It is the capital of the province, and was taken by the Spaniards in 1599, 108. 35. W. long. 35. 0. lat.

ACOMAC, a county of Virginia, in N. America, being a peninſula, bounded on the N. by Maryland; on the E. and S. by the ocean, and on the W. by the bay of Cheſe-peak. Cape Charles is at the entrance of the bay, being the moſt ſouthern promontory of this county.

ACONE, a ſpecies of whet-ſtone. See COS.

ACONITUM, in botany, a genus of the polyandria trigynia. There are ſeven ſpecies of the aconitum. 1. The lycoctonum, is a native of Lapland, Switzerland, and other hilly countries of Europe. 2. The uncinatum, is a native of Philadelphia. 3. The variegatum grows on the Italian and Bohemian mountains. 4. The napellus, is a native of Switzerland, Bavaria, and France. 5. The Pyrenaicum, is a native of Siberia, Tartary, and the Pyrenæan mountains. See plate II. fig. 2. 6. The cammarum, and, 7. The anthora, are both natives of Taurus and the Pyrenæan mountains. The Engliſh name of the aconitum is *wolfſbane* or *monkshood.* Each ſpecies is highly acrid, and extremely dangerous when taken into the ſtomach, as it generally occaſions convulſions, and frequently a mortification in that organ.

ACONTIAS, in zoology, an obſolete name of the anguis jaculus, or dart-ſnake, belonging to the order of amphibia ſerpentes. See ANGUIS.

ACONTIAS, is alſo a name applied by ſome writers to a kind of comet or meteor, whoſe head appears roundiſh or oblong, and its tail long and ſlender, like a dart or arrow.

ACONTIUM, in ancient writers, a kind of Grecian dart or javelin, ſomewhat reſembling the Roman pilum.

ACOPA, in botany, an obſolete name of a ſpecies of the trifolium, See TRIFOLIUM.

ACOPA, alſo ſignifies medicines for refreſhing the body after great fatigue.

ACOPAM. See ACOPA.

ACOPIS, a kind of foſſil, mentioned by Pliny.

ACOPUM, among ancient phyſicians, a topical medicine compoſed of warm and emollient ingredients for allaying the ſenſe of wearineſs.

ACORES, in geography. See AZORES.

ACORN, the fruit of the oak-tree. See QUERCUS.

ACORUM, in botany, a ſynonime of the acorus. See ACORUS.

ACORUS, in botany, the ſweet-ſmelling flag or calamus, a genus of the hexandria monogynia claſs. It is a native of this as well as other European countries. There are three varieties of this genus, *viz.* the acorus calamus; the vulgaris, or aromaticus of the ſhops; and the verus, which chiefly grows in the Indies.

ACORUS, in mat. med. a name ſometimes given to the great galangal. See GALANGAL

ACORUS, in botany, is likewiſe a ſynonime of the iris pſeudacorus. See IRIS.

ACOUSMATICI, ſometimes alſo called *Acouſtici*, in Grecian antiquity, ſuch diſciples of Pythagoras as had not completed their five years probation. See PYTHAGOREAN *philoſophy.*

ACOUSTIC, in general, denotes any thing that relates to the ear, or the ſenſe of hearing.

ACOUSTIC *duct*, in anatomy, the ſame with meatus auditorius, or the external paſſage of the ear. See ANATOMY, Part VI.

ACOUSTIC *inſtrument*, an inſtrument made in the form of a horn, perforated at the ſmall end, to aſſiſt hearing.

ACOUSTIC *nerve*, the ſame with the auditory nerve. See ANATOMY, Part V. and *Auditory nerve.*

ACOUSTICS, with phyſicians, medicines for curing deafneſs.

ACQS, a town at the foot of the Pyrenæan mountains in the government of Foix in France. It takes its name from the hot waters in theſe parts; 1. 25. E. long. 43. 0. lat.

ACQUA, a town in the Grand Dutchy of Tuſcany, where there are warm baths, 12. 5. E. long. 43. 45. lat.

ACQUA-CHE-TAVELLA, a celebrated fountain of Italy, in Calabria-citerior, a province of Naples. It is near the mouth of the river Crata, and the ruins commonly called *Sibari rovinata.* It has been ſaid to beautify thoſe who waſhed in it.

ACQUAPENDENTE, a pretty large town of Italy, in the territory of the church, and patrimony of St Peter, with a biſhop's ſee. It is ſeated on a mountain, near the river Paglia, 10 miles W. of Orvieto, and 57 N. by W. of Rome, 11. 53. E long. 42. 43. lat.

ACQUARIA, a ſmall town of Italy, in Frigana, a diſtrict of Modena, which is remarkable for its medicinal waters. It is 12 miles ſouth of the city of Modena, 11. 17. E. long. 44. 24. lat.

ACQUAVIVA, a ſmall town in the Terra di Bari, a province in the kingdom of Naples, 17. 25. E. long. 41. 10. lat.

ACQUEST,

ACQUEST, or ACQUIST, in law, signifies goods got by purchase or donation. See CONQUEST.

ACQUI, a town of Italy, in the Dutchy of Montserrat, with a bishop's see, and commodious baths. It was taken by the Spaniards in 1745, and retaken by the Piedmontese in 1746; but after this, it was taken again and dismantled by the French, who afterwards forsook it. It is seated on the river Bormio, 25 miles N. W. of Genoa, and 30 S. of Casal, 8. 30. E. long. 44. 40. lat.

ACQUIESCENCE, in commerce, is the consent that a person gives to the determination given either by arbitration, or by a consul.

ACQUIETANDIS *plegiis*, in the English law, is a writ that lies for a surety, against a creditor, who refuses to acquit the complainant after the debt is paid.

ACQUIETANTIA *de shiris et hundredis*, in England, signifies the privilege of being free from suit and service in shires and hundreds.

ACQUISITION, in general, denotes the obtaining or procuring something. Among lawyers, it is used for the right or title to an estate got by purchase or donation.

ACQUITARE, in ancient law-books, signifies to discharge or pay off the debts of a person deceased.

ACQUITTAL, a discharge, deliverance, or setting of a person free from the guilt or suspicion of an offence.

ACQUITTANCE, a release or discharge in writing for a sum of money.

ACRA, a town of Africa, on the coast of Guinea, where the English, Dutch, and Danes, have strong forts, and each fort its particular village, 0. 2. W. long. 5. 0. lat.

ACRASIA, among physicians, signifies the predominancy of one quality over another.

ACRE, or ACRA, a sea-port town in Syria. It was formerly called *Ptolemais*, and is a bishop's see. It was very famous in the time of the crusadoes, and underwent several sieges both by the Christians and Saracens. It is now an inconsiderable town, being entirely supported by its harbour, which is frequented by ships of several nations. It is 20 miles S. of Tyre, and 37 N. of Jerusalem, 39. 25. E. long. 32. 40. lat.

ACRE, in the Mogul's dominions, the same with lack, and signifies the sum of 100,000 rupees; the rupee is of the value of the French crown of 3 livres, or 30 sols of Holland; an 100 lacks of rupees make a couron in Indostan, or 10,000,000 rupees; the pound Sterling is about 8 rupees; according to which proportion, a lack of rupees amounts to 12,500 pounds Sterling.

ACRE, a measure of land used in several provinces of France, particularly in Normandy. It is larger or less according to the different places; but commonly contains 160 perches.

The ACRE *of woods in France*, consists of four roods, called *verges*; the rood is 40 perches, the perch 24 feet, the foot 12 inches, the inch 12 lines.

ACRE, the universal measure of land in Britain. An acre in England contains 4 square roods, a rood 40 perches or poles of $16\frac{1}{2}$ feet each by statute. Yet this measure does not prevail in all parts of England, as the length of the pole varies in different counties, and is called *customary measure*, the difference running from the $16\frac{1}{2}$ feet to 28. The acre is also divided into 10 square chains, of 22 yards each, that is 4840 square yards. An acre in Scotland contains 4 square roods; 1 square rood is 40 square falls; 1 square fall, 36 square ells; 1 square ell, 9 square feet, and 73 square inches; 1 square foot, 144 square inches. The Scots acre is also divided into 10 square chains; the measuring chain should be 24 ells in length, divided into 100 links, each link $8\frac{928}{1000}$ inches; and so 1 square chain will contain 10,000 square links.

The English statute acre is about 3 roods and 6 falls standard measure of Scotland.

ACREME, in old law-books, signifies ten acres of land.

ACRIBEIA, signifies great accuracy.

ACRID, a name for any thing that is of a sharp or pungent taste.

ACRIDOPHAGI, signifies *locust-eaters*. It has been much disputed whether the inhabitants of Arabia, Ethiopia, *&c.* ever eat locusts. We shall give the substance of what Hasselquist says on this subject, who travelled in Syria and Egypt so late as the year 1752. This ingenious gentleman, who travelled with a view to improve natural history, informs us, that he asked Franks, and many other people who had lived long in these countries, whether they had ever heard that the inhabitants of Arabia and Ethiopia, *&c.* used locusts as food. They answered that they had. He likewise asked the same question of Armenians, Cophtes, and Syrians, who lived in Arabia, and had travelled in Syria and near the Red-sea; some of whom said they heard of such a practice, and others that they had often seen the people eat these insects. He at last obtained complete satisfaction on this head from a learned sheck at Cairo, who had lived six years in Mecca. This gentleman told him, in presence of M. le Grand, the principal French interpreter at Cairo, and others, that a famine frequently rages at Mecca when there is a scarcity of corn in Egypt, which obliges the inhabitants to live upon coarser food than ordinary: That when corn is scarce, the Arabians grind the locusts in hand-mills, or stone mortars, and bake them into cakes, and use these cakes in place of bread: That he has frequently seen locusts used by the Arabians, even when there was no scarcity of corn; but then they boil them, stew them, with butter, and make them into a kind of fricassee, which he says is not disagreeably tasted; for he had sometimes tasted these locust-fricassees out of curiosity. From this account, we may see the folly of that dispute among divines about the nature of St John's food in the wilderness. Some of them say that locusts were the fruits of certain trees, others that they were a kind of birds, *&c.*; but those who adhered to the literal meaning of the text were at least the most orthodox, although their arguments were perhaps not so strong as they might have been, had they had an opportunity of quoting such an author as Hasselquist.

ACRI-

ACRIFOLIUM, in botany, a ſharp or prickly leaf.

ACRIMONY, that quality in bodies which renders them acrid to the taſte.

ACRIVIOLA, in botany, a ſynonime of a ſpecies of tropæolum or Indian creſs. See TROPÆOLUM.

ACROAMATIC, or ACROATIC, in general, denotes a thing ſublime, profound, or abſtruſe. Ariſtotle's lectures to his favourite diſciples and intimate friends bore this denomination, in oppoſition to his exoteric lectures, or thoſe accommodated to a popular audience.

ACROBATICA, or ACROBATICUM, in Grecian antiquity, an engine whereby the people were raiſed aloft, that they might ſee further, or with greater advantage. It was much the ſame with the ſcanſorium of the Latins.

ACROCHIRISMUS, in Grecian antiquity, a kind of gymnaſtic exerciſe, performed with the fiſts, without cloſing at all.

ACROCHORDON, a painful wart, which is very prominent and pendulous.

ACROCORION, in botany, an obſolete name of the crocus. See CROCUS.

ACROMATIC, or ACHROMATIC, in optics, a term applied to a particular kind of teleſcope, the moſt perfect of the refracting kind. See OPTICS and TELESCOPE.

ACROMION, in anatomy, the upper part of the ſcapula. See ANATOMY, Part I.

ACROMONOGRAMMATICUM, in poetry, a kind of poem, wherein every ſubſequent verſe begins with the letter wherewith the immediately preceding one terminated.

ACRON, a territory on the gold coaſt of Guinea in Africa, bordering on the Faatynean country. The Dutch have a fort here, called *Fort Patience*. The inhabitants apply themſelves principally to huſbandry. They are a very ignorant people, and go naked like the reſt of the negroes.

ACRON, among ancient botaniſts, ſignifies the top or flower of plants of the thiſtle kind.

ACRONICAL, ACHRONYCAL, or ACHRONICAL, in aſtronomy, is a term applied to the riſing of a ſtar, when the ſun is ſet in the evening; but has been promiſcuouſly uſed to expreſs a ſtar's riſing at ſunſet, or ſetting at ſunriſe.

ACROSPIRE, a vulgar term for what the botaniſts call the *plume*. See AGRICULTURE, *Of vegetation*.

ACROSPIRED, in malt-making, is the grain's ſhooting both at the root and blade end. See MALT.

ACROSTIC, ACROSTICUM, in poetry, a poem diſpoſed in ſuch a manner, that the initial letters of the verſes make ſome perſon's name, title, motto, *&c.*

ACROSTICUM, in botany, a genus of the cryptogamia filices, of which there are 30 ſpecies, but only three of them are natives of Britain, *viz.* the ſeptentrionale, or horned fern; the ilvenſe, or hairy fern; and the thelypteris, or marſh fern.

ACROSTOLIUM, in ancient naval architecture, the extreme part of the ornament uſed on the prows of their ſhips, which was ſometimes in the ſhape of a buckler, helmet, animal, *&c.*; but more frequently circular, or ſpiral. It was uſual to tear them from the prows of vanquiſhed veſſels, and fix them to the conquerors, as a ſignal of victory.

ACROTELEUTIC, among eccleſiaſtic writers, an appellation given to any thing added to the end of a pſalm, as the Gloria Patri or doxology.

ACROTERI, a town in the iſland of Santorin, that lies in the ſea of Candia, 25. 26. E. long. 36. 25. lat.

ACROTERIA, in architecture, ſmall pedeſtals, uſually without baſes, anciently placed at the middle and the two extremes of pediments or frontiſpieces, ſerving to ſupport the ſtatues, *&c.* It alſo ſignifies the figures placed as ornaments on the tops of churches, and the ſharp pinnacles that ſtand in ranges about flat buildings with rails and balluſters.

Among ancient phyſicians, it ſignified the larger extremities of the body, as the head, hands, and feet. It has alſo been uſed for the tips of the fingers, and ſometimes for the eminences or proceſſes of bones.

ACRITHYMIA, in ſurgery, a large tumour reſembling a wart, though ſometimes flat and depreſſed. See SURGERY, title, *Of tumours*.

ACSOR, a town in the river Nile in Egypt, famed for its earthen ware.

ACSU, a town in Aſiatic Tartary, ſituated in 40. 30. N. lat.

ACT, in general, denotes the exertion of power; and differs from power, as the effect from the cauſe.

ACT, among lawyers, is an inſtrument in writing for declaring or juſtifying the truth of any thing. In which ſenſe, records, decrees, ſentences, reports, certificates, *&c.* are called *Acts*.

ACTS, alſo denote the deliberations and reſolutions of an aſſembly, ſenate, or convocation, as, Acts of parliament, *&c.*

ACT *of faith*, *auta da fe*, in the Romiſh church, is a ſort of jail delivery, for the puniſhment of heretics, and the abſolution of thoſe who are found to be innocent. The culprits are firſt led to church, where their ſentence, either of condemnation or abſolution, is pronounced, and the guilty are delivered over to the ſecular power, with an earneſt interceſſion for them, that no blood may be ſhed. But if they perſiſt in their ſuppoſed errors, they are burnt alive. See INQUISITION.

ACTS, in dramatic poetry, are the parts or diviſions into which tragedies and comedies are generally ſplit. Dramatic compoſitions uſually conſiſt of five acts. But this diviſion is not eſſentially neceſſary, but may be varied according to the humour of the author, or the nature of the ſubject. See DRAMA.

ACT *of grace*. See GRACE.

ACTÆA, in botany, a genus of the polyandria monogynia claſs. There are three ſpecies of this plant, *viz.* the actæa ſpicata, or bone-berries, which is a native of Britain; the racemoſa, which is a native of America; and the cimicifuga, which is a native of Siberia.

ACTIAN *games*, in Roman antiquity, were ſolemn games

games instituted by Augustus, in memory of his victory over Marc Anthony at Actium, held every fifth year, and celebrated in honour of Apollo, since called *Actius*. Hence Actian years, an æra commencing from the battle of Actium, called the *Æra of Augustus*.

ACTION, in a general sense. See ACT.

ACTION, in mechanics, the motion produced by the impulse of one body upon another. See MECHANICS.

ACTION, in ethics, denotes the external signs or expressions of the sentiments of a moral agent. See ETHICS, METAPHYSICS.

ACTION, in poetry, the same with the subject or fable. Critics generally distinguish two kinds, the principal and the incidental. The principal action is what is generally called the *fable;* and the incidental an *episode*. See DRAMA.

ACTION, in oratory, is the outward deportment of the orator, or the accommodation of his countenance, voice, and gesture, to the subject of which he is treating. See ELOQUENCE.

ACTION, in a theatrical sense, is much the same with action in oratory; the one adapts his action to an assumed character, the other is supposed to feel in reality what he expresses.

ACTION, in painting and sculpture, is the posture of a statue or picture, serving to express some passion, *&c.*

ACTION, among physicians. See MOTIONS.

ACTION, in commerce, is a term used abroad for a part or share in a company's stock or capital.

ACTION, in Scots law, is a demand made before a judge for obtaining what we are legally intitled to demand, and is more commonly known by the name of law-suit or process. See LAW, title, *Actions*.

ACTIONARY, or ACTIONIST, a proprietor of stock in a trading company.

ACTIONS, among merchants, sometimes signify moveable effects; and we say the merchant's creditors have seized on all his actions, when we mean that they have taken possession of all his active debts.

ACTIVE, denotes something that communicates action or motion to another; in which acceptation it stands opposed to passive.

ACTIVE, in grammar, is applied to such words as express action; and is therefore opposed to passive. The active performs the action, as the passive receives it.

ACTIVE *principles*, in chemistry, such as are supposed to act without any assistance from others; as mercury, sulphur, *&c.* See CHEMISTRY.

ACTIVITY, in general, denotes the power of acting, or the active faculty. See ACTIVE.

Sphere of ACTIVITY, the whole space in which the virtue, power, or influence of any object is exerted

ACTIUS, in mythology, a sirname of Apollo, from Actium, where he was worshipped.

ACTOR, in general, signifies a person who acts or performs something.

ACTOR, in the drama, is a person who represents some part or character upon the theatre. The drama in its original only consisted of a simple chorus, who sung hymns in honour of Bacchus; so that the primitive actors were only singers and musicians. Thespis was the first who introduced a *persona*, or *actor*, to ease the chorus, by reciting the adventures of some of their heroes. Æschylus introduced a second, and changed the ancient recitals into dialogues. Sophocles added a third, in order to represent the variety of incidents in a more natural manner. And here the Greeks stopped; at least we do not find, in any of their tragedies, above three persons in the same scene, though, in their comedies, they took a greater liberty. The ancient actors were masked, which must have been a great disadvantage to their action, as they were thereby deprived of all the variety of expression the countenance is capable of. Actors were as much honoured at Athens, as they were despised at Rome. The French have, in this particular, adopted the manner of the Romans, and the English that of the Athenians. See DRAMA.

ACTORUM *tabulæ*, in antiquity, were tables instituted by Servius Tullius, in which the births of children were registered. They were kept in the treasury of Saturnus.

ACTRESS, a woman who performs a part upon the stage. Women actors were unknown to the ancients.

ACTUAL, something that is real and effective, or that exists truly and absolutely.

ACTUARIÆ *naves*, a kind of ships among the Romans, chiefly designed for swift sailing

ACTUARIUS, or ACTARIUS, a notary or officer appointed to write the acts or proceedings of a court, or the like. In the Eastern empire, the actuarii were properly officers who kept the military accounts, received the corn from the *susceptores*, or store-keepers, and delivered it to the soldiers.

ACTUATE, to bring into act, to put a thing in motion, or to stir up a person to action.

ACTUS, in ancient architecture, a measure in length equal to 120 Roman feet. In ancient agriculture, the word signified the length of one furrow, or the distance a plough goes before it turns.

ACTUS *minimus*, was a quantity of land 120 feet in length, and four in breadth.

ACTUS *major*, or ACTUS *quadratus*, a piece of ground in the square form, whose side was equal to 120 feet, equal to half the jugerum.

ACTUS *intervicenalis*, a space of ground four feet in breadth, left between the lands as a path or way.

ACUANITES, or ACUANITÆ, a branch of those ancient heretics who bore the general name of Manichees. This branch took their distinguishing title from Acua, a disciple of Thomas.

ACUBENE, in astronomy, the Arabic name of a star of the fourth magnitude, in the southern forceps of Cancer; by Bayer marked A. See ASTRONOMY and CANCER.

ACUHYTLI, a barbarous name of a species of serpent.

ACUITION. See ACUTITION.

ACULEATE, or ACULEATI, a term applied to any plant or animal armed with prickles.

ACULEATUS, in ichthyology, a synonime of the gasterosteus or stickle-back. See GASTEROSTEUS.

ACULEI, the prickles of animals or of plants.

ACULEOSA, in botany, a synonime of the gorteria ciliaris and the roella ciliata. See GORTERIA, ROELLA.

ACULER, in the menage, is used for the motion of a horse, when, in working upon volts, he does not go far enough forward at every time or motion, so that his shoulders embrace or take in too little ground, and his croupe comes too near the centre of the volt. Horses are naturally inclined to this fault in making demi-volts.

ACUMEN, in the ancient music, a sound produced by the intention or raising of the voice.

ACUMINA, in antiquity, a kind of military omen, most generally supposed to have been taken from the points or edges of darts, swords, or other weapons.

ACUMULO, a small town in Abruzzo Ulterior, a province of the kingdom of Naples, 17. 15. long. 39. 30. lat.

ACUPUNCTURE, the name of a surgical operation among the Chinese and Japanese, which is performed by pricking the part affected with a silver needle. They employ this operation in head-achs, lethargies, convulsions, colics, *&c.*

ACUS, in ichthyology, the trivial name of a species of syngnathus. See SYNGNATHUS.

ACUTE, as applied to angles, triangles, cones, *&c.* See these articles.

ACUTE *accent*, in grammar. See ACCENT.

ACUTE, in music, signifies a tone that is sharp, shrill, or high, in respect of some other, and is opposed to grave.

ACUTE *diseases*, such as come suddenly to a crisis. This term is used for all diseases which do not fall under the head of chronic diseases.

ACUTITION, among physicians, the sharpening or increasing the force of any medicine.

ACYROLOGIA, signifies an improper word, phrase, or expression.

AD, a Latin preposition, originally signifying *to*, and frequently used in composition both with and without the *d*, to express the relation of one thing to another.

AD *bestias*, in antiquity, is the punishment of criminals condemned to be thrown to wild beasts.

AD *hominem*, in logic, a kind of argument drawn from the principles or prejudices of those with whom we argue.

AD *ludos*, in antiquity, a sentence upon criminals among the Romans, whereby they were condemned to entertain the people either by fighting with wild beasts, or with one another, and thus executing justice upon themselves.

AD *metalla*, in antiquity, the punishment of such criminals as were condemned to the mines, among the Romans; and therefore called *Metallici*.

AD *quiddities*, among schoolmen. See QUIDDITIES.

AD *valorem*, a term chiefly used in speaking of the duties or customs paid for certain goods: The duties on some articles are paid by the number, weight, measure, tale, *&c.* and others are paid *ad valorem*, that is, according to their value.

ADA, a large town of Asia, inhabited chiefly by Armenians.

ADACA-MANGEN, in botany, a synonime of the sphæranthus. See SPHÆRANTHUS.

ADAGE, a proverb, or short sentence, containing some wise observation or popular saying.

ADAGIO, in music, an Italian adverb, signifying *softly*, *leisurely*; and is used to denote the slowest of all times, except the grave.

ADAJA, a river in Spain which falls into the Duro.

ADALIDES, in the Spainish policy, are officers of justice for matters touching the military forces, especially on expeditions.

ADAMANT, a name sometimes given to the diamond. See DIAMOND. It is likewise applied to the scoriæ of gold, the magnet, *&c.*

ADAMANTIC, in church history, a name given to the followers of Origen, sirnamed *Adamantius*.

ADAMBOE, in botany, a synonime of the ipomoea campanulata, an Indian plant, belonging to the pentandria monogynia class. See IPOMOEA.

ADAMI *pomum*, or *Adam's apple*, in botany, an obsolete name of a species of the citrus or orange. See CITRUS.

ADAMI *pomum*, in anatomy, the convex part of the first cartilage of the larynx. See ANATOMY, Part VI.

ADAMIC *earth*, a name given to common red clay, alluding to that species of earth of which the first man is supposed to have been made.

ADAMITES, in church history, a name sometimes used for the descendents of Adam by Seth, who are more usually called *Sethites*. But the name *Adamites* is more particularly used, by ecclesiastical writers, for a sect of ancient heretics, who took upon them to imitate the nakedness of Adam, and pretended to be reinstated in his original innocence.

ADAMSHIDE, a district of the circle of Rastenburg, belonging to the King of Prussia, which, with Dombrosken, was bought, in 1737, for 42,000 dollars.

ADAM'*s peak*, a high mountain of the E. Indies, in the island of Ceylon, on the top of which they believe the first man was created; and there is the shape of a man's foot, cut out of the rock, about five or six feet in length, which they pretend is the print of his foot, 80. 50. E. long. .5 55. lat.

ADANA, an ancient town of Natolia, with a bishop's see. It stands on the river Choquen, 25 miles N. E. of Tarsus, 36. 25. long. 38. 10. lat.

ADANSONIA, in botany, a genus of the monadelphia polyandria class. It is a native of Senegal and Egypt.

ADAOUS, or ADOWS, a people of Guinea in Africa.

ADAPTERS, in chemistry, machines for fitting a recipient to the capital. See CHEMISTRY.

ADAR, the name of a Hebrew month, answering to the end of February and beginning of March, the 12th of their sacred, and 6th of their civil year. On the

7th

7th day of it, the Jews keep a faſt for the death of Moſes; on the 13th, they have the faſt of Eſther; and on the 14th, they celebrate the feaſt of Purim, for their deliverance from Haman's conſpiracy.

ADARCE, a kind of concreted ſalts found on reeds and other vegetables, and applied by the ancients as a remedy in ſeveral cutaneous diſeaſes.

ADARCON, in Jewiſh antiquity, a gold coin mentioned in ſcripture, about the value of which authors are not agreed.

ADARE, a ſmall town of Ireland, in the county of Limmerick.

ADARME, in commere, a ſmall weight in Spain, which is alſo uſed at Buenos-Aires, and in all Spaniſh America. It is the 16th part of an ounce, which at Paris is called the *demi-gros*. But the Spaniſh ounce is ſeven *per cent.* lighter than that of Paris. Stephens renders it in Engliſh by a *dram*.

ADARTICULATION, in anatomy, the ſame with diarthroſis. See DIARTHROSIS.

ADATAIS, ADATIS, or ADATYS, in commerce, a muſlin or cotton-cloth, very fine and clear, of which the piece is ten French ells long, and three quarters broad. It comes from the E. Indies; and the fineſt is made at Bengal. See MUSLIN.

ADCHER, in the materia medica, a name given by ſome to the ſchœnanth. See SCOENANTH.

ADCORDABILES *denarii*, in ancient law-books, is money paid by the vaſſal to his lord, in the nature of a fine, upon ſelling or exchanging a feud.

ADCRESCENTES, among the Romans, denoted a kind of ſoldiery, entered in the army, but not yet put on duty; from theſe the ſtanding forces were recruited. See ACCENSI.

ADDA, in geography, a river of Switzerland and Italy, which riſes in mount Braulio, in the country of the Griſons, and paſſing through the Valteline, traverſes the lake Como and the Milaneſe, and falls into the Po, near Cremona.

ADDACE, in natural hiſtory, a name the Africans give to the common antelope. See GAZELLA.

ADDEPHAGIA, in medicine, a term uſed by ſome phyſicians, for gluttony, or a voracious appetite.

ADDER, in zoology, a vulgar name for the VIPER; which ſee.

ADDERS-TONGUE, in botany, the Engliſh name of the ophiogloſſum. See OPHIOGLOSSUM.

ADDER-WORT, in botany, the Engliſh name of the polygonum biſtata. See POLYGONUM.

ADDEXTRATORES, in the court of Rome, the pope's mitre-bearers, ſo called according to Ducange, becauſe they walk at the pope's right-hand, when he rides to viſit the churches.

ADDICE, or ADZE, a kind of crooked ax uſed by ſhip-wrights, carpenters, coopers, *&c.*

ADDICTI, in antiquity, a kind of ſlaves, among the Romans, adjudged to ſerve ſome creditor whom they could not otherwiſe ſatisfy, and whoſe ſlaves they became till they could pay, or work out the debt.

ADDICTION, among the Romans, was the making over goods to another, either by ſale, or by legal ſentence; the goods ſo delivered were called *bona addicta*. Debtors were ſometimes delivered over in the ſame manner; and thence called *ſervi addicti*.

ADDICTIO *in diem*, among the Romans, the adjudging a thing to a perſon for a certain price, unleſs by ſuch a day the owner, or ſome other, give more for it.

ADDITAMENT, a term ſometimes uſed by chemiſts and phyſicians for the addition of any new ingredient to increaſe the ſtrength of a menſtruum or compoſition.

ADDITION, is the joining together or uniting two or more things, or augmenting a thing by the acceſſion of others thereto.

ADDITION, in ARITHMETIC, ALGEBRA, LOGARITHMS, *&c.* ſee theſe articles.

ADDITION *of ratios*, a term ſometimes uſed for *compoſition of ratios*.

ADDITION, in muſic, a dot marked on the right ſide of a note, ſignifying that it is to be ſounded or lengthened half as much more as it would have been without ſuch mark.

ADDITION, in law, is that title or deſignation which is given to a man, over and above his proper name and ſirname, to ſhew of what eſtate, degree, occupation, or place he is.

ADDITIONS, in heraldry, ſome things added to a coat of arms, as marks of honour; and therefore directly oppoſite to abatements. Among additions we reckon BORDURE, QUARTER, CANTON, GYRON, PILE, *&c.* See theſe articles.

ADDITION, in diſtillery, a general name given to ſuch things as are added to the waſh or liquor while fermenting, to increaſe the vinoſity and quantity of the ſpirit, or give it a particular reliſh.

ADDITIVE, in general, ſomething to be added. Thus, mathematicians ſpeak of *additive ratios*, aſtronomers of *additive equations*, &c.

ADDOU, one of the Maldivian iſlands.

ADDRESS, a term often uſed to expreſs the ſkill and propriety with which an affair is conducted or managed.

An ADDRESS, in a particular acceptation, is a congratulation, petition, or remonſtrance, preſented to a ſuperior, eſpecially to the king.

ADDUCENT *muſcles*, or ADDUCTORS. See ADDUCTOR.

ADDUCTION, in anatomy, the motion or action of the adducent muſcles.

ADDUCTOR, in anatomy, the names of all muſcles which pull one part of the body towards another. See ANATOMY, Part II.

ADEA, in geography, a province of Annian, on the eaſtern coaſt of Africa, called alſo *Adel*.

ADEB, a large and uncertain Egyptian weight, uſed chiefly for rice.

ADEL, or ADEA, in geography, a kingdom of Africa, called alſo *Zeila*, from its capital town. It lies on the S. coaſt of the ſtrait of Babelmandel. There is ſeldom any rain here, and yet the country is fruitful, it being well watered with rivers. It abounds with wheat,

Plate III.

Fig. 1. ADONIS APPENINA

Fig. 2. ALAUDA *or Lark*

A. Bell Sculp.

wheat, millet, frankincenſe, and pepper. Their religion is the Mahometan.

Adel-*fiſh*, an obſolete name of the ſalmo albula, belonging to the order of abdominales. See Salmo.

ADEL-ODAGAM, in botany, a ſynonime of the juſticia bivalvis. See Justicia.

ADELIA, in botany, a genus of the diœcia monadelphia claſs. Of this genus there are three ſpecies; the bernardia, a native of America; and the ricinella and acidoton, both natives of Jamaica.

ADELPHIANI, in church hiſtory, a ſect of ancient heretics, ſo called from their leader *Adelphius*. They keep the ſabbath as a faſt.

ADELSCALC, in antiquity, a ſervant of the king; from the German, *adel*, noble, and *ſcalc*, a ſervant. They ſeem to have been the ſame with *royal thanes* among the Saxons, and the *miniſtri regis* in ancient charters.

ADELSPERG, a ſmall town of Germany, in lower Carniola.

ADEMPTION, in law, is the revocation of a donation, or grant, either directly by a deed or writ, or indirectly by otherwiſe diſpoſing of the ſubject of it. See Rescission.

ADEN, formerly a rich and conſiderable town of Arabia the Happy It is ſeated by the ſea-ſide, a little eaſtward of the ſtraits of Bebelmandel.

ADENANTHERA, in botany, a genus of the decandria monogynia claſs. There are only two ſpecies of this plant, the pavonina and the faleataria, both natives of India.

ADENBURG, or Aldenburg, in geography, a town of Weſtphalia, and in the dutchy of Burg, ſubject to the Elector Palatine. It is 12 miles N. E. of Cologne, and 17 W. of Bonn, 7. 25. E. long. 51. 2. lat.

ADENDUM, a ſmall town of Africa, in the kingdom of Fez.

ADENOGRAPHY, that part of anatomy which treats of the glandular parts.

ADENOIDES, in anatomy. See Prostates.

ADENOLOGY. See Adenography.

ADENOS, a kind of cotton otherwiſe called *marine cotton*. It comes from Aleppo by the way of Marſeilles, where it pays 20 *per cent*. duty, according to the tariff of the year 1766. Its valuation, according to the ſame tariff, is 76 livres 16 ſols.

ADENOSE *abſceſs*, a term ſometimes uſed for a hard tumour reſembling a gland.

ADEONA, in mythology, the name of a goddeſs invoked by the Romans when they ſet out upon a journey.

ADEPHAGIA, in mythology, the goddeſs of gluttony, to whom the Sicilians paid religious worſhip.

ADEPS, in anatomy, the fat found in the abdomen. It alſo ſignifies animal-fat of any kind.

ADEPTS, a term among alchemiſts for thoſe who pretended to have found out the panacea or philoſophers-ſtone.

ADEQUATE, ſomething equal to or exactly correſponding with another.

Adequate *idea*, ſignifies a diſtinct or perfect conception of all the qualities of any object.

ADERBERG, a town of Pomerania, ſituate on the Oder.

ADERBIGAN, a province of Perſia, bounded on the N. by Armenia Proper, on the S. by Irac-Agemi, on the E. by Ghilan, and on the W. by Curdiſtan. The principal town is Tauris, from 42. to. 48. long. from 36. to 39. lat.

ADERNO, a ſmall place in the Val di Demona in the kingdom of Sicily, 15. 25. E. long. 28. 5. lat.

ADESSENARIANS, Adessenarii, in church-hiſtory, a ſect of Chriſtians, who hold the real preſence of Chriſt's body in the euchariſt, though not by way of tranſubſtantiation. They differ conſiderably as to this preſence, ſome holding that the body of Chriſt is in the bread; others, that it is about the bread; and others, that it is under the bread.

ADFECTED *equation*. See Algebra.

ADFILIATION, a Gothic cuſtom, whereby the children of a former marriage are put upon the ſame footing with thoſe of the ſecond. This is alſo called *unio prolium*, and ſtill retained in ſome parts of Germany.

ADHATODA, in botany, a ſynonime of a ſpecies of ruelia, acanthus, and of two ſpecies of juſticia.

Action of ADHERENCE, in Scots law, an action competent to a huſband or wife, to compel either party to adhere, in caſe of deſertion. See Law, title, *Marriage*.

ADHERGAT, a town of Syria, near the frontiers of Arabia.

ADHESION, implies the ſticking or adhering of two bodies together.

Adhesion, in logic, ſignifies tenacioufneſs to an argument, without regard to any evidence of its truth.

Adhesion, in anatomy, a term for one part ſticking to another, which in a natural ſtate are ſeparate.

ADHOA, in ancient cuſtoms. See Relief.

ADJA, or Adga, a town of Guinea on the coaſt of Fantin.

ADJACENT, an appellation given to ſuch things as are ſituate near, or adjoining to each other.

ADIANTHUM, in botany, a genus of the cryptogamia filices, of which there are 19 ſpecies, and only two of them natives of Britain, *viz*. the adianthum capillus veneris, or true maiden-hair, and the trapeziforme, or ſhining maiden-hair.

ADIAPHORISTS, Adiaphoristæ, or Adiaphorites, in church-hiſtory, a name importing lukewarmneſs, given, in the ſixteenth century, to the moderate Lutherans, who embraced the opinions of Melancthon, whoſe diſpoſition was vaſtly more pacific than that of Luther.

ADJAZZO, in geography, a handſome town and caſtle of Corſica in the Mediterranean, with a biſhop's ſee, and a good harbour. It is populous, and fertile in wine. Some call it *Agaccio*. It is 27 miles S. W. of Corte, 8. 53. E. long. 41. 54. lat.

ADJECTIVE, in grammar, when joined to a ſubſtantive, imports ſome quality, or accident, or circumſtance belonging to that ſubſtantive.

ADIGE, in geography, a river in Italy, which taking its

its rise S. of the lake Glace, among the Alps, runs S. by Trent, then E. by Verona in the territory of Venice, and falls into the gulph of Venice, N. of the mouth of the Po.

ADJOURNMENT; the word imports putting off something to another day or time.

ADIPOSE, a term used by anatomists for any cell, membrane, *&c.* that is remarkable for its fatness.

ADVIRBEITSAN, in geography, a province of Persia, in Asia, and part of the ancient Media. It is bounded on the N. by the province of Shirvan, on the S. by Irac-Agemi and Curdistan, on the E. by Gilan and the Caspian sea, and on the W. by Turcomania.

ADIT, in general, signifies the passage to, or entrance of any thing, as the adit of a mine, *&c.*

ADJUDICATION, in Scots law, the name of that action by which a creditor attaches the heritable estate of his debtor, or his debtor's heir, in order to appropriate it to himself, either in payment or security of his debt; or, that action by which the holder of an heritable right, labouring under any defect in point of form, may supply that defect. See LAW, title, *Comprisings* and *adjudications*.

ADJUNCT, something added or joined to another. In rhetoric and grammar, they signify certain words or things added to others, to amplify or augment the force of the discourse.

ADJUTANT, in the military art, is an officer whose business it is to assist the major. Each battalion of foot and regiment of horse has an adjutant, who receives the orders every night from the brigade-major; which, after carrying them to the colonel, he delivers out to the serjeants. When detachments are to be made, he gives the number to be furnished by each company or troop, and assigns the hour and place of rendezvous. He also places the guards, receives and distributes the ammunition to the companies, *&c.* and by the major's orders, regulates the prices of bread, beer, and other provisions.—The word is sometimes used by the French for an *aid-du-camp*.

ADJUTANTS-*general*, among the Jesuits, a select number of fathers, residing with the general of the order, each of whom has a province or country assigned him, as England, Holland, *&c.* and their business is to inform the father-general of state-occurrences in such countries.

ADJUTORIUM, a term used by physicians for any medicine in a prescription but the capital one.

ADJUTORIUM, in anatomy, the same with the humerus or shoulder-blade. See HUMERUS.

ADLE-EGGS, such as have not received an impregnation from the semen of the cock.

ADLOCUTION, in Roman antiquity, is chiefly understood of speeches made by Roman generals, to their armies, to animate them with courage, before a battle.

ADMINICLES, in Scots law, signifies any writing or deed referred to by a party in an action of law, for proving his alledgeances or assertions.

ADMINICLES, among antiquarians, the ornaments wherewith Juno is represented on medals.

ADMINICULATOR, an ancient officer of the church, whose business it was to attend to, and defend the cause of widows, orphans, and others destitute of help.

ADMINISTRATION, in general, the government, direction, or management of affairs, and particularly the exercise of distributive justice; among ecclesiastics it is often used to express the giving or dispensing the sacraments, *&c.*

ADMINISTRATION, is also the name given by the Spaniards in Peru, to the staple magazine, or warehouse, established at Callao, a small town on the S. Sea, which is the port of Lima, the capital of that part of S. America, and particularly of Peru. The foreign ships, which have leave to trade along that coast, are obliged to unload here, paying 13 *per cent.* of the price they sell for, if the cargo be entire, and even 16 *per cent.* if otherwise; besides which they pay 3 *per* 1000, duty for consulship, and some other small royal rights and claims.

ADMINISTRATION, a term used by anatomists for the art of dissecting with propriety.

ADMINISTRATOR, in Scots law, a person legally impowered to act for another whom the law presumes incapable of acting for himself. Thus tutors or curators are sometimes styled *administrators in law* to pupils, minors, or fatuous persons. But more generally the term is used to imply that power which is conferred by the law upon a father over the persons and estates of his children during their minority. See LAW, title, *Minors, and their tutors and curators.*

ADMINISTRATOR, is sometimes used for the president of a province; for a person appointed to receive, manage, and distribute the revenues of an hospital or religious house; for a prince who enjoys the revenues of a secularized bishoprick; and for the regent of a kingdom, during a minority of the prince, or a vacancy of the throne.

ADMINISTRATRIX, a woman who acts as administrator.

ADMIRABILIS, in botany, a synonime of the mirabilis. See MIRABILIS.

ADMIRABILIS *sal*, the same with Glauber's salt. See GLAUBER'S SALT.

ADMIRAL, in maritime affairs, a great officer who commands the naval forces of a kingdom or state.

High ADMIRAL, in the law of Scotland, a judge invested with supreme jurisdiction in all maritime causes within Scotland. See LAW, title, *Supreme judges, and courts of Scotland.*

ADMIRAL also denotes the commander in chief of a single fleet or squadron; or, in general, any flag-officer whatever. In the British navy, besides the admiral who commands in chief, there are the vice-admiral, who commands the second squadron; and the rear-admiral, who commands the third. The admiral carries his flag at the main-top-mast-head; the vice-admiral at the fore-top-mast-head; and the rear-admiral at the mizen-top-mast-head. See FLAG.

Vice-ADMIRAL likewise denotes an officer invested with the jurisdiction of an admiral, within a certain district. There are a number of such in G. Britain.

ADMIRAL is alſo an appellation given to the moſt conſiderable ſhip of a fleet of merchant-men, or of the veſſels employed in the cod-fiſhery of Newfoundland. This laſt has the privilege of chuſing what place he pleaſes on the ſhore to dry his fiſh; gives proper orders, and appoints the fiſhing places to thoſe who come after him; and as long as the fiſhing-ſeaſon continues, he carries a flag on his main-maſt.

ADMIRAL, in zoology, the Engliſh name of a ſpecies of the voluta, a ſhell fiſh belonging to the order of vermes teſtacea. See VOLUTA.

High-Court of ADMIRALTY, in Scotland, the court in which the high-admiral is judge. See ADMIRAL.

ADMIRATION, in general, denotes ſurpriſe, wonder, or aſtoniſhment at any extraordinary event. Sometimes alſo it ſignifies the expreſſion of wonder.

ADMISSION, among eccleſiaſtical writers, is the act of a biſhop's allowing a clerk to be properly qualified for ſerving a cure.

ADMITTENDO *clerico*, in the Engliſh law, a writ granted to a perſon who has recovered his right of preſentation againſt the biſhop, *&c.* in the common pleas, by which the biſhop, or metropolitan is ordained to admit his clerk.

ADMITTENDO *in ſocium*, in the Engliſh law, a writ for the aſſociation of certain perſons to juſtices of aſſize formerly appointed.

ADMONITION, in eccleſiaſtical diſcipline, is a formal warning of an offender of his irregularities, and adviſing him to reform.

ADMONITIO *fuſtium*, among the Romans, a military puniſhment, not unlike our whipping, only it was performed with vine-branches.

ADMORTIZATION, in the feudal cuſtoms, the reduction of the property of lands or tenements to mortmain. See MORTMAIN.

ADNATA, in anatomy, one of the coats of the eye, which is alſo called *conjunctiva* and *albuginea*. See ANATOMY, Part VI.

ADNATA, is alſo uſed for any hair, wool, or the like, which grows upon animals or vegetables.

ADNOUN, a term uſed by ſome grammarians for an adjective.

AD *octo*, implied the higheſt degree of perfection, among ancient philoſophers.

ADOLESCENCE, the flower of youth, or time of growth in the human ſpecies, commencing at infancy, and terminating in manhood.

ADOLPH *Fredrick's Schacht*, a ſilver-mine in Sweden, which, from 1742 to 1747, produced a great deal of ſilver.

ADOM, in geography, a populous village in the province of Stuhl-Weiſſenberg, belonging to Hungary. It lies in a fruitful country, towards the river Danube, 19. 20. long. 47. 30. lat.

ADONAI, one of the names of the Supreme Being in the ſcriptures. The proper meaning of the word is *my lords*, in the plural number, as *Adoni* is *my lord* in the ſingular.

ADONIA, in mythology, feſtivals in honour of Venus, and in memory of Adonis, with whom ſhe is ſaid to have been in love.

ADONIAS, in botany, an obſolete name of the anemone. See ANEMONE.

ADONIDES, in botany, a name given to botaniſts who deſcribed or made catalogues of plants cultivated in any particular place.

ADONION, in botany, an obſolete name of a ſpecies of ſouthernwood.

ADONIS, in zoology. See EXOCOETUS.

ADONIS, in botany, a genus of the polyandria polygynia claſs. The Engliſh names are, adonis-flower, pheaſant's eye, red maithes, or red morocco. The calix of this genus is pentaphyllous, the petals are five, and the ſeeds are naked. There are five ſpecies of the adonis, *viz.* the æſtivalis, autumnalis, vernalis, appennina, and capenſis; none of which are natives of Britain, excepting the autumnalis. See Plate III. fig. 1. which repreſents the adonis appennina.

ADONIS *potio*, in antiquity, an ancient beverage made of wine, mixed with flower of roaſted adon. It was the ſame with cyceon.

ADOPTIANI, in church hiſtory, a ſect of antient heretics, followers of Felix of Urgel, and Elipand of Toledo, who, towards the end of the eighth century, advanced the notion, that Jeſus Chriſt, in his human nature, is the Son of God, not by nature, but by adoption.

ADOPTION, a ſolemn act whereby any one takes another man's ſon into his family, and makes him his heir, inveſting him with all the rights and privileges of a ſon.

ADOPTIVE, in general, ſignifies any thing adopted. Thus we ſay, *adoptive children*, &c.

ADOPTIVE *arms*, in heraldry, or, *arms of adoption*, thoſe which a perſon enjoys by the gift or conceſſion of another, and to which he was not otherwiſe intitled.

ADOPTIVI. See ADOPTIANI.

ADORATION, is the homage and ſubmiſſion due to the Supreme Being.

ADOSSEE, in heraldry, ſignifies two figures or bearings, being placed back to back. Thus the arms of the dutchy of Bar are two bars *adoſſee*, or back to back.

ADOUR, the name of a river of France, which riſes in the mountains of Bigorre, and running N. by Tarbes through Gaſcony; afterwards turns E. and, paſſing by Dax, falls into the bay of Biſcay, below Bayonne.

ADOXA, or TUBEROSE MOSCHATEL, in botany, a genus of the octandria tetragynia claſs. There is only one ſpecies of the adoxa, which is a native of Britain and other parts of Europe.

ADPERCEPTION, a term uſed by Leibnitz for the act whereby the mind becomes conſcious of its perceptions.

AD *pondus omnium*, among phyſicians, an abbreviation in their preſcriptions, ſignifying that the laſt mentioned ingredient is to weigh as much as all the reſt together.

AD *quod damnum*, in the Engliſh law, a writ directed to the ſheriff, commanding him to enquire into the damage which may befal from granting certain privileges to a place, as a fair, market, or the like.

ADRA,

ADRA, in geography, a sea-port town of Spain, in the kingdom of Granada, 37 miles S. E. of Granada, and 12 S. W. of Almeria, 1. 10. W. long. 36. 0. lat.

ADRACANTH. See TRAGACANTH.

ADRACHNE, in botany, an obsolete name of a species of arbutus. See ARBUTUS.

ADRAMMELECH, in antiquity, or mythology, a deity worshipped by the inhabitants of Sepharvaim, a people planted in the Holy Land by the kings of Assyria, after Salmanazar had taken Samaria, and put a final period to the kingdom of Israel. The worshippers of Adrammelech burnt their children in the fire to the honour of that idol. The name is Persian, and signifies *the magnificent king*.

ADRIUNE, in botany, an obsolete name of the cyclamen. See CYCLAMEN.

ADROBE, the name of two rivers in that part of Asiatic Tartary which is subject to Moscovy: They both fall into the Wolga beneath Cazan.

ADSCRIPTS, a term used by some mathematicians for the natural tangents. See TANGENT.

ADSIDELLA, in antiquity, the table at which the flamens sat during the sacrifices.

ADSTAT, a small town belonging to Denmark in the island of Iceland, not far from Holar.

ADSTRICTION, among physicians, a term used to denote the rigidity of any part.

ADVANCE, in the mercantile style, denotes money paid before goods are delivered, work done, or business performed.

ADVANCED *ditch*, in fortification, is that which surrounds the glacis or esplanade of a place.

ADVANCED *guard*, or *vanguard*, in the art of war, the first line or division of an army, ranged, or marching in order of battle; or, it is that part which is next the enemy, and marches first towards them.

ADVANCED *guard*, is more paticularly used for a small party of horse stationed before the main-guard.

ADVANCER, among sportsmen, one of the starts, or branches of a buck's attire, between the back antler and the palm.

ADUAR, in the Arabian and Moorish customs, a kind of ambulatory village, consisting of tents, which these people remove from one place to another, as suits their conveniency.

ADVENT, in the kalendar, properly signifies the approach of the feast of the Nativity. It includes four sundays, which begin on St Andrew's day, or on the Sunday before or after it. During advent, and to the end of the octaves of Epiphany, the solemnizing of marriage is forbid, without a special licence.

ADVENTITIOUS, an epithet applied to any thing that is accidental or fortuitous.

AD VENTREM *inspiciendum*, in law, a writ by which a woman is to be searched whether she be with child by a former husband, on her with-holding of lands from the next, failing issue of her own body.

ADVENTURE, in a general sense, some extraordinary or accidental event. It also denotes a hazardous or difficult undertaking.

Bill of ADVENTURE, among merchants, a writing signed by a merchant, testifying the goods mentioned in it to be shipped on board a certain vessel belonging to another person, who is to run all hazards; the merchant only obliging himself to account to him for the produce.

ADVENTURER, in a general sense, denotes one who hazards something.

ADVERB, in grammar, a word joined to verbs, expressing the manner, time, *&c.* of an action: thus, in the phrase, *he was warmly attached to the interest of his master*, the word *warmly* is an adverb. See GRAMMAR.

ADVERSARIA, among the ancients, a book of accounts, not unlike our journals, or day-books. It is more particularly used for a kind of common-place-book. See COMMON-PLACE-BOOK.

ADVERSARY, a person who is an enemy to, or opposes another.

ADVERSATIVE, in grammar, a word expressing some difference between what goes before and what follows it. Thus, in the phrase, *he is an honest man, but a great enthusiast*, the word *but* is an adversative conjunction.

ADVERSATOR, in antiquity, a servant who attended the rich in returning from supper, to give them notice of any obstacles in the way, at which they might be apt to stumble.

ADVERTISEMENT, in a general sense, denotes any information given to persons interested in an affair; and is more particularly used for a brief account of an affair inserted in the public papers, for the information of all concerned.

ADULT, an appellation given to any thing that is arrived at maturity: Thus we say, an adult person, an adult plant, *&c.* Among civilians, it denotes a youth between fourteen and twenty-five years of age.

ADULTERATION, the act of debasing, by an improper mixture, something that was pure and genuine.

ADULTERY, an unlawful commerce between one married person and another, or between a married and unmarried person. See SCOTS LAW, titles, *Marriage, and Crimes*.

ADVOCATE, among the Romans, a person who undertook the defence of causes. The term is still kept up in all countries where the civil law obtains.

King's ADVOCATE, is the principal crown-lawyer in Scotland. His business is to act as a public prosecutor, and to plead in all causes that concern the crown; but particularly in such as are of a criminal nature. The office of King's advocate is not very ancient: It seems to have been established about the beginning of the 16th century. Originally he had no power to prosecute crimes without the concurrence of a private party; but in the year 1597, he was impowered to prosecute crimes at his own instance.

Faculty of ADVOCATES, in Scotland, a respectable body of lawyers, who plead in all causes before the Courts of Session, Justiciary, and Exchequer. They are also intitled to plead in the house of peers, and other supreme courts in England.

In the year 1660, the faculty founded a library upon

upon a very extensive plan, suggested by that learned and eminent lawyer Sir George M'Kenzie of Rosehaugh, advocate to King Charles II. and King James VII. who enriched it with many valuable books. It has been daily increasing since that time, and now contains not only the best collection of law-books in Europe, but a very large and select collection of books on all subjects. Besides, this library contains a great number of original manuscripts, and a vast variety of Jewish, Grecian, Roman, Scots, and English coins and medals.

A candidate for the office of an advocate undergoes three several trials: The first is in Latin, upon the civil law and Greek and Roman antiquities; the second, in English, upon the municipal law of Scotland; and in the third, he is obliged to defend a Latin thesis, which is impugned by three members of the faculty. Immediately before putting on the gown, the candidate makes a short Latin speech to the lords, and then takes the oaths to the government and *de fideli*.

The faculty at present consists of above 200 members. As an advocate or lawyer is esteemed the genteelest profession in Scotland, many gentlemen of fortune take the degree of advocate, without having any intention of practising at the bar. This circumstance greatly increases their number, gives dignity to the profession, and enriches their library and public fund. It is from this respectable body, that all vacancies on the bench are generally supplied.

Fiscal ADVOCATE, *fisci advocatus*, in Roman antiquity, an officer of state under the Roman Emperors, who pleaded in all causes wherein the *fiscus*, or private treasury, was concerned.

Consistorial ADVOCATES, officers of the consistory at Rome, who plead in all oppositions to the disposal of benefices in that court; they are ten in number.

ADVOCATE *of a city*, in the German polity, a magistrate appointed in the Emperor's name to administer justice.

Bill of ADVOCATION, in Scots law, a writing drawn up in the form of a petition, whereby a party, in an action before an inferior court, applies to the supreme court, or court of Session, for calling the action from the inferior court before itself. See LAW, title, *Jurisdiction, and judges in general.*

Letters of ADVOCATION, in Scots law, the decree or warrant of the court of Session upon cognisance of the facts set forth in the bill, drawn up in the form of a summons, and passing under the signet, discharging the inferior judge and all others from further procedure in the cause, and advocating it to itself. See *Bill of* ADVOCATION.

ADVOCATIONE *decimarum*, a writ which lies for claiming a fourth part for tithes, or upwards, belonging to any church.

ADVOUSON, or ADVOUZEN. See ADVOWZON.

ADVOU, in law, signifies the patron of a church, or he who has a right to present to a benefice.

Paramount ADVOWEE, is used for the king, as being the highest patron.

ADVOWING. See AVOWING.

ADVOWTRY, a term used in some old law-books for adultery.

ADVOWZON, in law, is the right of patronage, or presenting to a vacant benefice.

ADUST, among physicians, a term applied to the blood, *&c.* when too hot and fiery.

ADUSTION, among physicians, the same with inflammation.

ADYTUM, in pagan antiquity, the most retired and sacred place of their temples, into which none but the priests were allowed to enter.

ADZEL, a small town of Livonia, situated on the south-side of the river Aa, about ten German leagues south-west of Dorpt.

ÆACEA, in Grecian antiquity, solemn festivals and games celebrated at Ægina, in honour of Æacus; who, on account of his justice upon earth, was thought to to have been appointed one of the judges in hell.

ÆCHMALOTARCHA, in Jewish antiquity, the title given to the principal leader or governor of the Hebrew captives residing in Chaldea, Assyria, and the neighbouring countries.

ÆDES, in Roman antiquity, besides its more ordinary signification of a house, likewise signified an inferior kind of temple, consecrated to some deity.

ÆDICULA, a term used to denote the inner part of the temple, where the altar and statue of the deity stood.

ÆDILATE, the office of ædile, sometimes called *ædility*. See the next article.

ÆDILE, in Roman antiquity, a magistrate whose business it was to superintend buildings of all kinds, but more especially public ones, as temples, aquæducts, high-ways, bridges, *&c.*

ÆDITUUS, in Roman antiquity, an officer belonging to the temples, who had the charge of the offerings, treasure, and sacred utensils. The female deities had a woman-officer of this kind called *æditua*.

ÆGAGROPILA, a ball composed of a substance resembling hair, generated in the stomach of the chamois-goat. This ball is of the same nature with those found in cows, hogs, *&c.*

ÆGILETHRON, in botany, an obsolete name of the mercurialis. See MERCURIALIS.

ÆGIAS, among physicians, a white speck on the pupil of the eye, which occasions dimness of sight.

ÆGILOPS, among physicians, a species of abscess. See SURGERY, title, *Of abscesses*, or *tumors*.

ÆGILOPS, in botany, a genus of the polygamia monœcia class. There are five species of this plant, which is a kind of grass, *viz.* the ovata, caudata, squarrosa, triuncialis, and incurvata, only the last of which is a native of Britain, and grows by the sea-shore. The English name is *sea-hard-grass*.

ÆGINETIA, in botany, a synonime of a species of orobanche. See OROBANCHE.

ÆGIPAN, in heathen mythology, a denomination given to the god Pan, because he was represented with the horns, legs, feet, *&c.* of a goat.

ÆGIS, in heathen mythology, is particularly used for the shield or cuirass of Jupiter and Pallas.

ÆGIUCHUS, in heathen mythology, a sirname of Jupiter,

piter, given him on account of his having been ſuckled by a goat.

ÆGLEFINUS, or HADDOCK, in ichthyology, a ſpecies of the gadus. See GADUS.

ÆGOCEPHALUS, in ornithology, an obſolete name of a ſpecies of tringa. See TRINGA.

ÆGOCERAS, in botany, an obſolete name of a ſpecies of ononis. See ONONIS.

ÆGOCERATOS, in botany, a ſynonime of the hugonia. See HUGONIA.

ÆGOLETHRON, in botany, an obſolete name of the rhododendron hirſutum. See RHODODENDRON.

ÆGONICHUS, in botany, an obſolete name of the lithoſpermum. See LITHOSPERMUM.

ÆGOPHTHALMUS, a name given to any of the ſemipellucid gems with circular ſpots in them, reſembling the eye of a goat.

ÆGOPOGON, in botany, an obſolete name of the tragapodon. See TRAGAPODON.

ÆGOPODIUM, a genus of the pentandria digynia claſs. There is but one ſpecies of this plant, which is a native of Britain and other parts of Europe. The Engliſh name is *herb-gerurd*, *gout-weed*, or *aſh-weed*.

ÆGYPTIACUM, in pharmacy, the name of ſeveral detergent ointments.

ÆGYPTILLA, the name of a ſtone variegated with different colours, and ſaid to be capable of giving water the colour and taſte of wine.

ÆINAUTÆ, in antiquity, a denomination given to the ſenators of Miletus, becauſe they held their deliberations on board a ſhip, and never returned to land till matters had been agreed on.

ÆLURUS, in Egyptian mythology, the deity or god of cats; repreſented ſometimes like a cat, and ſometimes like a man with a cat's head.

ÆNEATORES, in Roman antiquity, a general name for the muſicians of an army.

ÆNIGMA, denotes any dark ſaying, wherein ſome well-known thing is concealed under obſcure language.

ÆNIGMATOGRAPHY, or ÆNIGMATHOLOGY, the art of reſolving, or making ænigmas.

ÆOLIC, in a general ſenſe, denotes ſomething belonging to Æolis.

ÆOLIC *dialect*, among grammarians, one of the five dialects of the Greek tongue, agreeing in moſt things with the Doric dialect. See DORIC.

ÆOLIC *verſe*, in proſody, a verſe, conſiſting of an iambus, or ſpondee; then of two anapeſts, ſeparated by a long ſyllable; and laſtly, of another ſyllable. Such as,

O ſtelliferi conditor orbis.

ÆOLIPILE, a hollow metalline ball with a ſlender neck, or pipe; which after being filled with water, and a great degree of heat applied to it, the water iſſues out with great velocity in the form of an elaſtic vapour. See PNEUMATICS.

ÆOLIS, in ancient geography, a country lying upon the weſtern coaſt of Aſia Minor.

ÆOLUS, the god of the winds.

ÆON, ſignifies the age or duration of any thing.

ÆON, among the Platoniſts, was uſed to denote any virtue, attribute, or perfection.

ÆON, in mythology, the firſt woman, according to the Phœnician writers.

ÆON, among anatomiſts, an obſolete name for the ſpinal marrow.

ÆONIAN, in botany, an obſolete name of the ſedum majus. See SEDUM.

ÆRA, in chronology, a ſeries of years commencing from a certain fixed point of time, called an *epocha*; thus we ſay, the Chriſtian æra, that is, the number of years elapſed ſince the birth of Chriſt. See ASTRONOMY, *Of the diviſion of time.*

ÆRA *of Nabonaſſar.* See NABONASSAR.

ÆRA *of the Hegira.* See HEGIRA.

ÆRARIUM, in Roman antiquity, the treaſury or place where the public money was depoſited.

ÆRARIUM *privatum*, was the emperor's privy purſe, or place where the moneys ariſing from his private patrimony were depoſited.

ÆRARIUS, in a general ſenſe, denotes any perſon employed in coining or managing the public monies.

ÆRARIUS was more particularly uſed by the Romans for a degraded citizen, whoſe name had been ſtruck off the liſt of his century.

The ærarii were ſo called on account of their being liable to all the taxes and other burdens of the ſtate, without enjoying any of its privileges. Hence, *inter ærarios referri*, was a more ſevere puniſhment than *tribu moveri*.

AERIAL, in a general ſenſe, denotes ſomething partaking of the nature of air; thus, aerial ſubſtance, aerial particles, *&c.*

AERIANS, in church-hiſtory, a branch of Arians, who, to the doctrines of that ſect, added ſome peculiar dogmas of their own; as, that there is no difference between biſhops and prieſts; a doctrine maintained by many modern divines, particularly of the preſbyterian and reformed churches.

AERICA, in ichthyology, a ſynonime of the clupea herengus, or herring. See CLUPEA.

Flos ÆRIS, among alchemiſts, ſmall ſcales procured from copper melted by a ſtrong heat; it is ſometimes uſed for ærugo or verdegris.

AEROGRAPHY ſignifies a deſcription of the air, eſpecially of its dimenſions, and other moſt obvious properties; in which ſenſe it differs but little from *aerology*, which is a ſcientifical account of the nature and leſs obvious properties of air. See PNEUMATICS.

AEROMANCY, a ſpecies of divination performed by means of air, wind, *&c.* It is alſo uſed for the art of foretelling the various changes of the air and weather, by means of barometers, hygrometers, *&c.*

AEROMETRY, the art of meaſuring the motion, gravity, elaſticity, rarefaction, condenſation, *&c.* of air. See PNEUMATICS.

AEROPHOBIA, among phyſicians, ſignifies the dread of air.

AEROPHYLACEA, a term uſed by naturaliſts for caverns or reſervoirs of air, ſuppoſed to exiſt in the bowels of the earth.

ÆRRA, a ſmall town of Portugal, in the province of Eſtramadura, ſituated upon the river Zatas.

AERESCHOT, a town of the Dutch Netherlands, ſituated in Brabant, about fifteen miles eaſtward of Mechlin.

ÆRUGINOUS, in ornithology, the trivial name of a ſpecies of falco. See FALCO.

ÆRUGINOUS, an epithet given to ſuch things are reſemble or partake of the nature of the ruſt of copper.

ÆRUGO, properly ſignifies the ruſt of copper, or verdegris; but is applied indifferently to ruſt of any kind.

ÆRUGO *ſalis*, a kind of reddiſh ſlimy matter, ſeparated from Egyptian *natrum*; probably a mixture of bitumen and a red earth.

ÆRUSCATORES, in antiquity, a kind of ſtrolling beggars, not unlike gypſies, who drew money from the credulous by fortune-telling, *&c.* It was alſo a denomination given to gripping exactors, or collectors of the revenue.

AERY, or AIRY, among ſportſmen. See AIRY.

ÆS, properly ſignifies copper, or money coined of that metal. See COPPER.

ÆS *flavum*, yellow copper, among the Romans, an appellation given to the coarſer kinds of braſs. See BRASS.

ÆS *caldarium*, the name of a certain regulus of antimony, employed in preparing the fine blue colour called *ſmalt*.

ÆS *uſtum*, a preparation of copper, by expoſing plates of it in a reverberatory furnace, till they crumble into a powder, which is called *æs uſtum*. It is uſed for colouring glaſs, eating off dead fleſh, or cleanſing foul ulcers.

ÆSALON, in ornithology, an obſolete name of a ſpecies of falco. See FALCO.

ÆSCH, in ichthyology, an obſolete name of a ſpecies of ſalmo. See SALMO.

ÆSCHYNOMENE, in botany, a genus of the diadelphia decandria claſs. There are ſeven ſpecies of this genus, none of which are natives of Britain. The calix of the æſchynomene is bilabiated, and the pod jointed. It is alſo a ſynonime of ſeveral ſpecies of the mimoſa, or ſenſitive plant. See MIMOSA.

ÆSCULANUS, or ÆRES, in mythology, a deity who preſided over the coinage of copper-money.

ÆSCULAPIUS's *ſerpent*, or COLUBER ÆSCULAPII. See COLUBER.

ÆSCULUS, in botany, a genus of the heptandria monogynia claſs. There are only two ſpecies of it, *viz.* the caſtanum, and the pavia, both natives of India. The calix of the æſculus is monophyllous with five teeth; the corolla has five petals unequally coloured, and inſerted into the calix.

ÆSTIMATIO *capitis*, a term met with in old law-books for a fine anciently ordained to be paid for offences committed againſt perſons of quality, according to their ſeveral degrees.

ÆSTIVAL, in a general ſenſe, denotes ſomething connected with, or belonging to ſummer. Hence, æſtival ſign, æſtival ſolſtice, *&c.*

ÆSTUARIA, in geography, denotes an arm of the ſea, which runs a good way within land. Such is the Briſtol channel, and many of the friths of Scotland.

ÆSTUARIES, in ancient baths, were ſecret paſſages from the hypocauſtum into the chambers. See BATH, and HYPOCAUSTUM.

ÆSTUARY, among phyſicians, a vapour-bath, or any other inſtrument for conveying heat to the body.

ÆTH, or ATH, a ſtrong little town in the Auſtrian Netherlands, and province of Hainault, ſituated on the river Dender, about twenty miles S. W. of Bruſſels.

ÆTHALE, a term uſed by the ancients for the cadmia fornacum. See CADMIA.

ÆTHALIES, a name given by the Greeks to the ſedum. See SEDUM.

ÆTHER, the name of an imaginary fluid, ſuppoſed by ſeveral authors, both ancient and modern, to be the cauſe of gravity, heat, light, muſcular motion, ſenſation, and, in a word, of every phænomenon in nature. Anaxagoras maintained that æther was of a ſimilar nature with fire; Perrault repreſents it as 7200 times more rare than air; and Hook makes it more denſe than gold itſelf. Whoever has an inclination to know the various hypotheſes concerning æther, may conſult Shebbere, Perrault, Hook's poſthumous works, *Act. Erud.* Lipſ. 1716, Bernouilli's *Cogitat. de gravitate ætheris*, &c. &c.

Before the method of philoſophiſing by induction was known, the hypotheſes of philoſophers were wild, fanciful, ridiculous. They had recourſe to æther, occult qualities, and other imaginary cauſes, in order to explain the various phænomena of nature: But ſince the days of the great Lord Verulam, who may be ſtyled the parent of genuine philoſophy, a contrary courſe has happily been followed. He convinced the world, that all knowledge muſt be derived from experiment and obſervation; and that every attempt to inveſtigate cauſes by any other means muſt be unſucceſsful. Since his time, the beſt philoſophers have followed the tract which he pointed out. Boyle, Locke, Newton, Hales, and a few others, in little more than one century, have improved and extended ſcience far beyond what the accumulated force of all the philoſophers ſince the creation had been able to effectuate: A ſtriking proof both of the comprehenſive genius of Bacon, and of the ſolidity of his plan of inveſtigation.

It muſt indeed be acknowledged, that there is a propenſity in the human mind, which, unleſs it be properly reſtrained, has a direct tendency both to corrupt ſcience, and to retard our progreſs in it. Not contented with the examination of objects which readily fall within the ſphere of our obſervation, we feel a ſtrong deſire to account for things which, from their very nature, muſt, and ever will, elude our reſearches. Even Sir Iſaac Newton himſelf was not proof againſt this temptation. It was not enough that he had diſcovered the nature of light and colours, the application of gravity to the motions of the heavenly bodies, *&c.* he muſt go further, and attempt to aſſign the cauſe of gravity itſelf. But, how does he proceed in this matter? Not in the

the way of experiment, which had led him to his former diſcoveries, but in the way of conjecture, which will never lead any man to truth. He had recourſe to a ſubtile elaſtic æther, not much different from that of the ancients, and by it accounted for every thing he did not know, ſuch as the cauſe of gravitation, muſcular motion, ſenſation, *&c.*

Notwithſtanding the reputation of Sir Iſaac, philoſophers have generally looked upon this attempt as the foible of a great man, or, at leaſt, as the moſt uſeleſs part of his works; and accordingly peruſe it rather as a dream or a romance, than as having any connection with ſcience. But we are ſorry to find, that ſome late attempts have been made to revive this doctrine of æther, particularly in a diſſertation *De ortu animalium caloris*, publiſhed in May laſt.

As the revival of an old doctrine becomes in ſome meaſure a new one, we ſhall plead no other apology for inſerting a ſpecimen of the method of reaſoning employed in this diſſertation.

The author makes frequent uſe of a ſpecies of argument termed *dilemma* by logicians. For example, in the firſt part of the work, after endeavouring to prove that animal heat cannot be owing to fermentation, the motion of the fluids, and other cauſes that have uſually been aſſigned, he draws this concluſion:— "If none of theſe cauſes are ſufficient to produce the "effect; therefore, by dilemma," ſays he, "it muſt be "ſought for in the nature and action of the nerves."—This is a new ſpecies of dilemma:—If the author had proved, that the cauſe of heat in animals could not poſſibly exiſt *any where*, but *either* in fermentation, the motion of the fluids, *&c.* *or* in the nerves, after having diſproved its exiſtence in all the reſt, his concluſion in favour of the nerves would have been juſt; but, as he has not ſo much as attempted this, the concluſion is not only falſe, but ridiculous.

However, upon the authority of this dilemma, the author firſt gives what he calls a Compend of a *new* doctrine concerning the nerves, and then proceeds to inquire in what manner the nerves produce animal heat: He tells us, "That *thought* (*cogitatio*) and ſenſation depend "upon impulſes either on the extremities of the nerves, "or the ſenſorium commune, and the conſequent mo-"tions produced by theſe impulſes: That theſe motions "are ſo quick, as to be almoſt inſtantaneous: That as "all motion is mechanical; therefore *thought*, ſen-"ſation, and muſcular motion, muſt likewiſe be me-"chanical: That ſuch quick motions cannot be pro-"duced without the intervention of ſome extreme-"ly elaſtic power; and, as Sir Iſaac Newton has "ſhown, that the impulſes which occaſion the diffe-"rent ſenſations muſt be owing to an elaſtic power; "therefore the muſcular motions of animals muſt be "occaſioned by the oſcillations of ſome elaſtic power." "But," ſays he, "as this elaſtic power cannot ex-"iſt in the ſolid nervous fibres, nor in any inelaſtic "fluid; therefore, by *dilemma*, it muſt exiſt in an "elaſtic fluid; and hence alſo, by the former *dilemma*, "this elaſtic fluid muſt be ſeated, either in the nerves, "or in their medullary ſubſtance."

Here again the author calls Sir Iſaac into his aſſiſtance.—"What confirms this opinion," ſays he, "is "the Newtonian æther, which pervades all nature, "and which, with a few variations in its modification, "Sir Iſaac has ſhown to be the cauſe of coheſion, e-"laſticity, gravity, electricity, magnetiſm, *&c.* in "the following manner: 1. As the rays of light, "when reflected, do not touch the ſolid parts of bo-"dies, but are reflected a little before they reach "them, it is plain that the æther not only fills the "pores of bodies, but likewiſe floats upon their ſur-"faces; and hence it becomes the cauſe of attraction "and repulſion.—2. All metals, and inelaſtic fluids, "are non-electrics; on the other hand, all ſolid bo-"dies, metals excepted, are electrics, *i. e.* proper for "accumulating æther. But æther, thus accumulated "in ſuch a variety of bodies, may produce various "motions in the parts of theſe bodies, without indu-"cing any change in the bodies themſelves. Hence "æther, with ſome variations in its modification, is "ſufficient to account for all the phænomena of elec-"tricity. 3. As iron, by accumulating æther around "it, exhibits all the wonders of magnetiſm; ſo this "magnetical æther is more analogous to the nervous "æther of animals than any other kind of it. For, "as the magnetical æther paſſes along iron without "changing any part of the iron; ſo the nervous æther, "in like manner, paſſes along the medullary ſubſtance "of the nerves, and excites motion in any part that is "continuous with them, without inducing any change "in the nerves.—4. The irritability and life of "plants, which very much reſemble thoſe in animals, "cannot be explained by any inelaſtic cauſe, and "muſt therefore be attributed to an ætherial one. "Laſtly, As the common æther is differently modi-"fied in each of the ſubſtances above taken notice "of, and alſo produces various motions or effects pe-"culiar to each, it likewiſe varies and has ſome pe-"culiar qualities when reſiding in animal bodies; ſo "that the nervous or animal æther is not exactly the "ſame, but differs in ſome reſpects from thoſe ſpecies "of æther which give riſe to coheſion, gravity, mag-"netiſm, electricity," *&c.*

Having thus explained the nature and qualities of æther, our author ſtarts a very important queſtion, *viz.* "Whence is æther derived? and whether does it leave "any body after having once got poſſeſſion of it?" In anſwer to this, he obſerves, "That certain bodies "have the power of collecting the electrical matter "from every circumjacent body, and of accumula-"ting it in their pores and on their ſurfaces, but do "not ſuffer it again to tranſmigrate into any other "body. There are other ſubſtances of an oppoſite "nature, which do not accumulate the electric mat-"ter, but inſtantly allow it to paſs into others, unleſs "prohibited by an electric. Hence," ſays he, "no-"thing more is neceſſary for ſubſtances of the former "kind, but to be in ſuch circumſtances as allow them "to accumulate the electric matter. In the ſame "manner," proceeds our author, "the nervous æther, "which is diffuſed through every part of nature,

"flows

“ flows copiouſly into the medullary part of the nerves,
“ when no obſtacle ſtands in its way: but, when once
“ it has got there, it keeps firm poſſeſſion, and never
“ afterwards leaves it. Now,” ſays he, “ a quan-
“ tity of æther probably conſtitutes one of the ſtami-
“ nal parts of animal bodies, and increaſes in propor-
“ tion to their age and growth: For nothing is more
“ *ridiculous* than to ſuppoſe that what is commonly
“ called *the nervous fluid* can be daily waſted by la-
“ bour and exerciſe, and daily repaired by a new ſe-
“ cretion from the brain. To refute this *vulgar* no-
“ tion, nothing more is neceſſary than to ſay, That
“ it is *one of Boerhaave's theories*, and *muſt be falſe*,
“ as all Boerhaave's other theories have been proved
“ to be ill-founded! But æther is of a more fixed
“ and determinate nature; whenever *it* gets poſſeſſion
“ of any ſubſtance, it never forſakes it, unleſs the
“ texture and conſtitution of the body itſelf be chan-
“ ged. Hence,” continues our author, “ the æther
“ of an acid body remains as long as the body conti-
“ nues to be acid; the ſame obſervation holds with
“ regard to the æther of an alkaline body: But, if
“ theſe two be blended together into a neutral ſalt,
“ the æther muſt likewiſe be changed into a *neutral*;
“ and therefore, in the formation of the medullary
“ or ſtaminal part of animals, the æther which before
“ belonged to, or had the properties of ſome other ſub-
“ ſtance, is inſtantaneouſly changed into animal æther,
“ and remains ſo till the diſſolution of that animal.”

Our author next obſerves, “ That bodies require to
“ be in a certain ſtate or condition in order to the for-
“ mation of an æther that is proper for them. This
“ condition of bodies is called an *excited ſtate*: Thus,
“ as ſulphur, when fluid, does not receive the electric
“ matter, but, when ſolid, inſtantly receives it; in
“ the ſame manner, the nerves, though properly
“ formed, do not admit an æther adapted to their
“ nature, unleſs they be in an excited ſtate. Hence,”
ſays he, “ the æther of a *dead*, and that of a *living*
“ perſon, are very different, although the texture and
“ figure of the nerves be the ſame. The ſtate neceſ-
“ ſary for conſtituting the æther of a living animal,
“ ſeems to depend on heat and moiſture; becauſe theſe
“ things are abſolutely neceſſary in the conſtitution of
“ life: And hence,” concludes our author, “ the ex-
“ cited ſtate of the nerves depends on heat and moi-
“ ſture. There are alſo certain circumſtances,” ſays
he, “ which contribute to render the ſtate of the
“ nerves more or leſs apt for accumulating æther: A
“ ſpaſmodic fever, for example, renders the nerves of
“ the whole body leſs pervious to the motion of the
“ æther; and hence, in caſes of this nature, *health*,
“ and all the *vital functions*, muſt be injured.”

“ Theſe,” our author obſerves, “ are the outlines
“ of a *new* doctrine concerning the nature and func-
“ tions of the nerves;” and, upon this *foundation*,
proceeds to give his *new theory* of animal heat.

“ From the foregoing *reaſoning*,” ſays he, “ the
“ heat, as well as all the functions of animals, ſeem
“ to be occaſioned by the oſcillations of the nervous
“ æther betwixt the extremities of the ſentient nerves
“ and the brain, or, more properly, betwixt the brain
“ and muſcles. But electrical æther, as above ob-
“ ſerved, varies a little from common æther; all in-
“ elaſtic fluids, as was likewiſe formerly remarked,
“ are non-electrics; and all ſolid bodies, metals ex-
“ cepted, are electrics: Theſe circumſtances,” ſays
our author, “ ſeem to be owing to the oſcillations of
“ the electric matter in bodies. In the ſame manner,”
ſays he, “ the nature of animals may be ſuch, and the
“ nerves may be ſo conſtituted, as to form an æther ad-
“ apted to their nature, and to excite thoſe oſcillations
“ which occaſion animal heat. The wonderful effects
“ of heat and cold upon the nerves,” continues our
author, “ confirms this theory: Every action, and
“ even life itſelf, requires a certain degree of heat;
“ for, as the heat of the external air is ſo variable, it
“ was abſolutely neceſſary that animal bodies ſhould
“ be endowed with the faculty of producing a degree
“ of heat ſuited to their nature, independent of ex-
“ ternal circumſtances: Hence we ſee the reaſon why
“ the degree of heat ſo ſeldom varies in the ſame ſpe-
“ cies of animals. However, although the nervous
“ æther is always ready for exciting heat by its oſcil-
“ lations; yet, in order to bring about this effect ſuc-
“ ceſsfully, external *ſtimuli* are neceſſary, otherwiſe
“ the æther would be in danger of *ſtagnating*, which
“ would occaſion ſleep, a palſy, and, laſt of all, death.
“ The moſt permanent of theſe *ſtimuli* is the pulſa-
“ tion of the arteries; which is the reaſon why heat
“ is ſo connected with the circulation of the blood,
“ and why many authors have miſtaken it for the true
“ cauſe of animal heat.”

Our author now concludes with obſerving, “ That
“ by his theory, the varieties of heat in different parts
“ of the body, the heat and fluſhing of the face from
“ ſhame, and all the other phænomena of heat in ani-
“ mal bodies, admit of a better explanation, than by
“ any other theory hitherto invented.”

Having thus given a pretty full account of an attempt to explain the moſt abſtruſe operations of nature, as nearly as poſſible in the very words of the author, we cannot deny ourſelves the liberty of making a few obſervations.

To give a formal refutation of this author's reaſoning, is no part of our plan. It is, perhaps, wrong to ſay that he has *reaſoned*; for the whole hypothetical part of his eſſay is a mere farrago of vague aſſertions, non-entities, illogical concluſions, and extravagant fancies. His æther ſeems to be an exceedingly tractable ſort of ſubſtance: Whenever the qualities of one body differ from thoſe of another, a *different modification of æther* at once ſolves the phænomenon. The æther of iron muſt not, to be ſure, be exactly the ſame with the nervous æther, otherwiſe it would be in danger of producing ſenſation in place of magnetiſm. It would likewiſe have been very improper to give the vegetable æther exactly the ſame qualities with thoſe of animal æther; for, in ſuch a caſe, men would run great riſk of ſtriking root in the ſoil, and trees and hedges might eradicate and run about the fields. Nothing can be more ludicrous than to ſee

a writer treating a mere *ens rationis* as familiarly as if it were an object of our senses: The notion of compounding the æther of an *acid* and that of an *alkali*, in order to make a *neutral* of it, is compleatly ridiculous. But if men take the liberty of substituting *names* in place of *facts* and *experiments*, it is an easy matter to account for any thing.

By this method of philosophising, obscurity is for ever banished from the works of nature. It is impossible to gravel an ætherial philosopher. Ask him what questions you please, his answer is ready:—"As we "cannot find the cause *any where* else; ergo, by di-"lemma, it must be owing to æther!" For example, ask one of those sages, What is the cause of gravity? he will answer, 'Tis *æther!* Ask him the cause of *thought*, he will gravely reply, "The solution of "this question was once universally allowed to ex-"ceed the limits of human genius: But now, by "the grand *discoveries* we have lately made, it is "as plain as that three and two make five:—*Thought* "is a mere *mechanical* thing, an evident effect of cer-"tain motions in the brain produced by the *oscilla-*"*tions* of a subtile elastic fluid called *æther!*" This is indeed astonishing!

Such jargon, however, affords an excellent lesson to the true philosopher. It shows to what folly and extravagance mankind are led, whenever they deviate from experiment and observation in their inquiries into nature. No sooner do we leave these only faithful guides to science, than we instantly land in a labyrinth of nonsense and obscurity, the natural punishment of folly and presumption.

When endeavouring to account for that propensity in the human mind which prompts us to attempt the solution of things evidently beyond our reach, we recollected a passage in Swift's works, which explains it in the most satisfactory manner.

"Let us next examine (says the Dean) the great "introducers of new schemes in philosophy, and "search till we can find from what faculty of the soul "the disposition arises in mortal man, of taking it "into his head to advance new systems, with such an "eager zeal, in things agreed on all hands *impossible* "*to be known*; from what feeds this disposition "springs, and to what quality of human nature these "grand innovators have been indebted for their num-"ber of disciples; because it is plain, that several of "the chief among them, both *ancient* and *modern*, "were usually mistaken by their adversaries, and in-"deed by all except their own followers, to have been "persons crazed, or out of their wits; having gene-"rally proceeded, in the common course of their "words and actions, by a method very different from "the vulgar dictates of *unrefined* reason; agreeing, "for the most part, in their several models, with "their present undoubted successors in the *Acade-*"*my* of *modern Bedlam*. Of this kind were *Epi-*"*curus*, *Diogenes*, *Apollonius*, *Lucretius*, *Paracel-*"*sus*, *Des Cartes*, and others; who, if they were "now in the world, tied fast, and separated from "their followers, would, in this *undistinguishing* age, "incur manifest danger of *phlebotomy*, and *whips*, "and *chains*, and *dark chambers*, and *straw*. For "what man, in the natural state or course of think-"ing, did ever conceive it in his power to reduce the "notions of all mankind exactly to the same length, "and breadth, and height of his own? Yet this is "the first *humble* and *civil* design of all innovators in "the empire of reason.——Now, I would gladly "be informed, how it is possible to account for such "imaginations as these in particular men, without re-"course to my *phænomenon* of vapours, (*i. e.* æther), "ascending from the lower faculties to overshadow "the brain, and there distilling into conceptions, for "which the narrowness of our mother-tongue has not "yet assigned any other name besides that of *madness* "or *phrenzy*. Let us therefore now conjecture how "it comes to pass that none of these great projectors "do ever fail providing themselves and their notions "with a number of *implicit disciples*; and I think "the reason is easy to be assigned.—For there is a "peculiar string in the harmony of human understand-"ing, which, in several individuals, is exactly of the "same tuning. This if you can dextrously *screw* "up to its right key, and then *strike gently* upon it, "whenever you have the good fortune to light among "those of the *same pitch*, they will, by a secret ne-"cessary sympathy, strike exactly at the same time. "And in this one circumstance lies all the *skill* or "*luck* of the matter: For if you chance to jar the "string, among those who are either above or be-"low your own height, instead of subscribing to your "doctrine, they will *tie you fast*, call you *mad*, and "*feed* you with *bread* and *water*. It is therefore a "point of the nicest conduct, to distinguish and adapt "this noble talent with respect to the difference of "*persons* and of *times*.—For, to speak a bold truth, "it is a fatal miscarriage so ill to order affairs as to "pass for a *fool* in one company, when in another "you might be treated as a *philosopher*: Which I de-"sire *some certain gentlemen of my acquaintance* to "lay up in their hearts as a very *seasonable innu-*"*endo*."

We would not have dwelt so long upon this article, had it not been to guard, as far as our influence extends, the minds of those who may be unacquainted with the genuine principles of philosophy, from being led into a wrong track of investigation.

Æther, in chymistry, a name given to any volatile spirit. The spirit which generally goes by that name is procured by distilling spirit of wine with oil of vitriol, and then precipitating with an alkali. See Chemistry.

ÆTHERIAL, an epithet for any thing partaking of the nature of æther.

ÆTHIOPIS, in botany, a synonime of a species of salvia. See Salvia.

ÆTHIOPS *mineral*, a preparation of mercury made by rubbing equal quantities of quicksilver and flour of sulphur in a mortar, till the mercury wholly disappears, and a fine black powder remains.

Æthiops *albus*, a preparation of mercury made by rubbing

rubbing quickſilver with a double quantity of crabs-eyes or candied ſugar, till it is extinguiſhed.

ÆTHIOPS *of Dr Plumber*, a medicine prepared by levigating fulphur auratum antimonii with an equal quantity of calomel.

ÆTHUSA, in botany, a genus of the pentandria digynia claſs. The volucrum is dimidiated, triphyllous, and pendulous. There is but one ſpecies, *viz.* the æthuſa ſynapium, or fools-parſley, a native of Britain.

AETIANS, in church-hiſtory, a branch of Arians who maintained, that the Son and Holy Ghoſt are in all things diſſimilar to the Father.

ÆTIOLOGY, that branch of phyſic which aſſigns the cauſes of diſeaſes.

ÆTITÆ, or ÆTITÆS, a name given to pebbles or ſtones of any kind which have a looſe nucleus rattling in them, called, in Engliſh, *Eagle-ſtones*.

ÆTNA, a famous burning mountain or volcano of Sicily. It is one of the higheſt mountains of the whole iſland, and ſituated on the eaſtern coaſt not far from Catania. It is remarked of this mountain, that its eruptions ceaſed immediately when thoſe of Veſuvius began. See VESUVIUS.

ÆTNA *ſalt*, a name uſed by ſome authors for ſaline ſubſtances, found near the opening of mount Ætna and other volcanos.

ÆTOLARCHA, in Grecian antiquity, the principal magiſtrate or governor of the Ætolians.

AFFA, a weight uſed on the gold-coaſt of Guinea, and equal to an ounce.

AFFECTIO *bovina*, a diſorder incident to cattle, occaſioned by a ſmall worm which eats its way all over the body.

AFFECTION, in a general ſenſe, denotes an attribute inſeparable from its ſubject, or an eſſential property of it. Thus, quantity, figure, weight, *&c.* are affections of all bodies.

AFFECTIONS *of the mind*. See PASSIONS, and MORALS.

AFFEERERS, or AFFEERORS, in law, perſons appointed in court-leets, courts-baron, *&c.* to ſettle, upon oath, the fines to be impoſed upon thoſe who have been guilty of faults arbitrarily puniſhable.

AFFERI, in law. See AVERIA.

AFFETUOSO, or *con* AFFETTO, in the Italian muſic, intimates, that the part to which it is added ought to be played in a tender moving way, and conſequently rather ſlow than faſt.

AFFIANCE, in law, denotes the mutual plighting of troth between a man and a woman to marry each other.

AFFICHE, a term uſed by the French for bills or advertiſements hung or paſted up in public places to make any thing known.

AFFIDATIO *dominorum*, in old law-books, denotes an oath of allegiance taken by the lords in parliament.

AFFIDATUS, or AFFIDIATUS, in old law-books, ſignifies a tenant by fealty, or one who put himſelf under the protection of his lord, vowing fealty to him.

AFFIDAVIT, ſignifies an oath in writing, ſworn before ſome perſon who is authoriſed to take the ſame.

AFFILIATION, a term uſed by ſome for adoption. See ADOPTION.

AFFINAGE, a term ſometimes met with in old law-books, for the refining of metals.

AFFINITY, in Scots law, the connection formed by marriage betwixt one of the married perſons and the blood-relations of the other. See LAW, title, MARRIAGE.

AFFINITY, is alſo uſed to denote conformity or agreement: Thus we ſay, the affinity of languages, the affinity of words, the affinity of ſounds, *&c.*

AFFINITY of bodies. See CHEMISTRY, chapter, *Of elective attractions*.

AFFIRMATION, in logic, the aſſerting the truth of any propoſition.

AFFIRMATION, is alſo uſed for the ratifying or confirming the ſentence or decree of ſome inferior court: thus we ſay, the houſe of lords affirmed the decree of the lord-chancellor, or the decree of the lords of ſeſſion.

AFFIX, among grammarians, denotes much the ſame with prefix. See PREFIX.

AFFLATUS, among heathen mythologiſts and poets, denotes the inſpiration of ſome divinity.

AFFORAGE, in the French cuſtoms, a duty paid to the lord of a diſtrict, for permiſſion to ſell wine or other liquors within his ſeigniory. It is alſo uſed for the rate or price of proviſions fixed by the provoſt of Paris, or by the ſheriffs.

AFFORCEMENT, among old law-writers, denotes a fortreſs or place of ſtrength.

AFFORCIAMENTUM *curiæ*, a term uſed in old charteraly for the ſummoning a court in an extraordinary manner.

AFFORESTING, in old law-books, is the turning lands into a foreſt; as the converting a foreſt to other uſes is called *diſafforeſting*, or *deafforeſting*.

AFFRAY, or AFFRAYMENT, in law, formerly ſignified the crime of affrighting other perſons, by appearing in unuſual armour, brandiſhing a weapon, *&c.* but at preſent, affray denotes a ſkirmiſh or fight between two or more.

AFFREIGHTMENT, a term uſed in ſome law-books for the freight of a ſhip.

AFFRI, or AFRA, a term met with in old law-books for horſes, bullocks, or any beaſt uſed in ploughing.

AFFRONTEE, in heraldry, an appellation given to animals facing one another on an eſcutcheon, a kind of bearing, which is otherwiſe called *confrontée*, and ſtands oppoſed to *adoſſée*.

AFFUIAGE, in ancient cuſtoms, denotes the right or privilege of cutting wood in a foreſt for fuel.

AFILIATION. See AFFILIATION.

AFOBA, in botany, an obſolete name of the phaſeolus or kidney-bean. See PHASEOLUS.

AFRA *avis*, an obſolete name of the meleagris, or turkey. See MELEAGRIS.

AFRA, or AFRUM, in botany, a ſynonime of a ſpecies of guaiacum. See GUAIACUM.

AFRICA, one of the four principal diviſions of the earth;

earth; divided from Europe on the N. by the Mediterranean ſea; from America on the W. by the Atlantic ocean; from the countries towards the ſouth-pole, by the Great South-ſea; from the iſland of Madagaſcar in the E. by the Mozambique channel; and from Aſia alſo on the E. by the Red-ſea. It is alſo joined to Aſia by a narrow neck of land betwixt the Mediterranean and Red-ſea, called *the iſthmus of Suez*: Hence Africa is a peninſula ſomewhat reſembling a pyramid, whoſe baſe from Tangier to the iſthmus of Suez is about 2000 miles; its perpendicular, from the vertex at the cape of Good Hope to Buria, 3600 miles; and from cape Verd, to cape Guard a Fui, it is 3500. The ſituation of this quarter on the globe is betwixt 35. 0. S. and 36. 0. N. lat. and betwixt 17. 35. W. and 53. 21. E. long. Hence it lies, for the moſt part, within the tropics; by which means, in many places, the heat is almoſt inſupportable. Along the coaſts, it is in general reckoned abundantly fruitful, and its produce excellent. The Romans very juſtly conſidered Africa as the *patria ferarum*, for there is no other place breeds the number or the variety. In this quarter there are ſeveral deſarts, ſome of them of vaſt extent, covered with ſand, by which whole caravans have been ſometimes ſmothered. The principal rivers are the Nile and the Niger, the firſt of which diſembogues itſelf into the Mediterranean, after traverſing Abyſſinia, Nubia, and Egypt; and the laſt into the Atlantic ocean, by a weſtern courſe from Upper Ethiopia. Geographers are not yet agreed about the ſources of either of theſe rivers; according to ſome, their ſources are not far diſtant from each other. There are ſome mountains in Africa remarkably high, particularly in Abyſſinia and Barbary, in which laſt is the famous mount Atlas, which ſeparates Barbary from Biledulgerid. The prevailing religions here, are Mahometaniſm and Paganiſm: Chriſtianity only takes place among the Abyſſinians and European ſettlements. The government in Africa is in general deſpotic, and the inhabitants black. In the diviſion, geographers have gone variouſly to work; we ſhall confine ourſelves to the more general, *viz.* EGYPT, BARBARY, GUINEY, CONGO, CAFFRARIA, ABYSSINIA, NUBIA, and NIGRITIA, with the iſlands that ſurround it; for which, ſee theſe articles.

AFRICA, is alſo a conſiderable ſea-port town of Barbary, about ſeventy miles S of Tunis.

AFRICA, *Afrique*, is likewiſe a ſmall town of France, ſituated in the province of Gaſcony, and generality of Montauban.

AFRICAN *company*, a ſociety of merchants, eſtabliſhed by King Charles II. for trading to Africa; which trade is now laid open to all his majeſty's ſubjects, paying 10 *per cent.* for maintaining the forts.

AFSAGERS, perſons appointed by the burgo-maſters of Amſterdam, to preſide over the public ſales made in that city.

AFT, in the ſea-language, the ſame with abaft. See ABAFT.

AFTER-BIRTH, in midwifery. See MIDWIFERY, and SECUNDINES.

AFTER-MATH, in huſbandry, ſignifies the graſs which ſprings or grows up after mowing.

AFTER-PAINS, in midwifery, pains in the groin, *&c.* after child-birth. See MIDWIFERY, title, *After-pains*.

AFTER-SWARMS, in the management of bees, are thoſe which leave the hive ſome time after the firſt has ſwarmed. See APIS.

AFTO, in botany. See ERYSIMUM.

AGA, in the Turkiſh language, ſignifies a great lord or commander. Hence the Aga of the janiſſaries is the commander in chief of that corps; as the general of the horſe is denominated *ſpahiclar aga.* See JANISSARIES, and SPAHI.

AGADES, or AGDES, a people or kingdom of Africa, lying on the northern bank of the river Niger, betwixt the kingdoms of Cano on the E. and Tombut on the W. with that of Zaara on the N.

AGADES, or ANDEGAST, the capital city of the ſaid kingdom.

AGADES, is alſo the Mooriſh name for the town of Santa-Cruz, in the the kingdom of Sus.

AGAG, or ARGAGA, a kingdom of Africa, dependent on the kingdom of Monomotapa.

AGAI, in commerce. See AGIO.

AGAI, is alſo the name of a people of Ethiopia, inhabiting near the ſource of the Nile, and profeſſing a kind of Chriſtanity.

AGALLOCHA, in botany, the trivial name of the excœcaria. See EXCOECARIA.

AGALMATA, in antiquity, a term originally uſed for any kind of ornaments in a temple, but afterwards for the ſtatues only.

AGANIPPIDES, in ancient poetry, a deſignation given to the muſes, from a fountain of mount Helicon called *Aganippe*.

AGAPÆ, or AGAPES, in church-hiſtory, certain love-feaſts kept by the ancient Chriſtians, as a token of brotherly charity and mutual benevolence.

However innocent the original intention of theſe feſtivals might have been, abuſes in time got footing in them, and gave great occaſion to ſcandal; ſo that it became neceſſary to forbid the kiſs of charity between different ſexes, as well as to have any beds or couches in the place where they aſſembled.

AGAPETÆ, in church-hiſtory, a kind of nuns among the primitive Chriſtians, who attended on and ſerved the clergy.

At firſt there was nothing ſcandalous in thoſe ſocieties, though they gave great offence afterwards, and were wholly aboliſhed by the council of Lateran, in 1139.

AGARENI, a name uſed by ſome writers for the Arabs, as being deſcended from Agar, or Hagar, Abraham's hand-maid.

AGARICO-*fungus*, in botany, a ſynonime of the agaricus alneus, or alder-agaric.

AGARICO-*pylorus*, a ſynonime of the boletus verſicolor. See BOLETUS.

AGARICUS, in botany, a genus of the cryptogamia fungi. Of this genus there are 28 ſpecies, 24 of which

are natives of Britain. Several ſpecies of the agaric grow upon the trunks of the larch, the oak, and other trees. It is of a ſpungy ſubſtance, reſembling the muſhroom, and irregular in its figure and ſize. This plant has of late been tried for ſtopping hæmorrhages after amputations: but the ſucceſs has not been ſo remarkable as to bring it into general uſe.

Mineral AGARIC, a marley earth reſembling the vegetable of that name in colour and texture. It is found in the fiſſures of rocks, and on the roofs of caverns; and is ſometimes uſed as an aſtringent in fluxes, hæmorrhages, *&c.*

AGASYLLIS, a name uſed by the Greeks for ammoniac. See AMMONIAC.

AGAT, is a ſtone reſembling the onyx in colour, but, in place of zones, is adorned with lines or ſpots of various colours, which run into ſo many figures, as to reſemble trees, flowers, fruits, herbs, *&c.* Of the agat there are ſeveral ſpecies, diſtinguiſhed from each other chiefly by their colour; as, the white-veined agat, the lead-coloured agat, the fleſh-coloured agat, *&c.*

AGAT, is alſo the name of an inſtrument uſed by gold-wire-drawers, ſo called from the agat in the middle of it, which forms its principal part.

AGATA, or *St* AGATA *di Goti*, a city and biſhop's ſee of Naples, and province of Principato, ſituated almoſt in the middle between Capua and Beneventum.

AGATONSI, a ſmall iſland of the Archipelago, ſituated between that of Leſbos and the continent.

AGATTON, a town of Africa, on the coaſt of Guiney, ſituated near the mouth of the river Formoſa, about eighty miles ſouth of Benin.

AGATY, in botany, a ſynonime of the æſchynomene. See ÆSCHYNOMENE.

AGAVE, in botany, a genus of the hexandria monagynia claſs. Under this genus Linnæus ranks 4 ſpecies of the Aloes, *viz.* the america, vivipara, virginica, and fœtida. See ALOE.

AGAZES, a name given to the inhabitants of Paraguay in S. America.

AGDE, a ſmall but well inhabited city of France, in the province of Languedoc, near the mouth of the river Eraut, about thirty miles S. W. of Montpelier. It is the ſee of a biſhop.

AGE, a certain portion or part of duration applied to the exiſtence of particular objects: thus we ſay, the age of the world, the age of Rome, *&c.* that is, the time or number of years elapſed ſince the creation of the world, or the building of Rome. See ASTRONOMY, *Of the diviſion of time.*

The ancient poets alſo divided the duration of the world into four ages or periods; the firſt of which they called the *golden age*; the ſecond the *ſilver age*, the third the *brazen age*, and the fourth the *iron age*.

AGE, in law, ſignifies a certain period of life, when perſons of both ſexes are enabled to do certain acts: thus, a man at twelve years of age ought to take the oath of allegiance to the king in a leet; at fourteen he may marry, chuſe his guardian, and claim his lands held in ſoccage.

Twenty-one is called full age, a man or woman being then capable of acting for themſelves, of managing their affairs, making contracts, diſpoſing of their eſtates, and the like.

AGE-PRIER, *ætatem precari*, in law, is when an action being brought againſt a perſon under age, for lands deſcended to him, he, by motion or petition, ſhews the matter to the court, praying the action may be ſtaid till his full age; which the court generally agrees to.

AGE *of the moon*, in aſtronomy, the time elapſed ſince her laſt conjunction with the ſun. See ASTRONOMY.

AGEDA, in geography, a ſmall town and river of Portugal, ſituated in the province of Beiran, between the cities of Oporto and Coimbra.

AGEMA, in Macedonian antiquity, was a body of ſoldiery, not unlike the Roman legion. See LEGION.

AGEMOGLANS, or AGIAMOGLANS, or AZAMOGLANS, in the Turkiſh cuſtoms, Chriſtian children raiſed every third year, by way of tribute, from the Chriſtians tolerated in the Turkiſh empire.

AGEN, an ancient city of France, in the province of Guienne, ſituated on the river Garronne, about ſixty miles S. E. of Bourdeaux. It is a biſhop's ſee, and the capital of the Agenois.

AGENDA, among philoſophers and divines, ſignifies the duties which a man lies under an obligation to perform: thus, we meet with the agenda of a Chriſtian, or the duties he ought to perform, in oppoſition to the credenda, or things he is to believe.

AGENDA, among merchants, a term ſometimes uſed for a memorandum book, in which is ſet down all the buſineſs to be tranſacted during the day, either at home or abroad.

AGENHINE, the ſame with hogenhine. See HOGENHINE.

AGENOIS. See AGEN.

AGENORIA, in mythology, the goddeſs of courage and induſtry, as Vacuna was of indolence.

AGENT, in a general ſenſe, denotes any active power or cauſe. Agents are either natural or moral. Natural agents are ſuch inanimate bodies as have a power to act upon other bodies in a certain and determinate manner, as gravity, fire, *&c.* Moral agents, on the contrary, are rational creatures, capable of regulating their actions by a certain rule.

AGENT, is alſo uſed to denote a perſon intruſted with the management of an affair, whether belonging to a ſociety, company, or private perſon.

AGENTS *of bank and exchange*, in the commercial polity of France, are much the ſame with our exchange-brokers.

AGENT *and patient*, in law, is ſaid of a perſon who is the doer of a thing, and alſo the party to whom it is done.

AGENTS *in rebus*, in antiquity, ſignifies officers employed under the emperors of Conſtantinople, and differing only in name from the frumentarii, whom they ſucceeded. See FRUMENTARII.

AGER, in Roman antiquity, a certain portion of land allowed to each citizen. See AGRARIAN LAW.

Ager, is alſo uſed by middle-age writers, for an acre of land. See Acre.

Ager *mineralium*, among chemiſts, ſignifies the element of water, as water is ſuppoſed to be the origin of minerals.

Ager *naturæ*, a name ſometimes applied to the uterus, as it nouriſhes the ſemen in the ſame manner as the earth nouriſhes ſeeds.

Ager, in geography, a ſmall town of Catalonia in Spain, ſituated near the ſource of the river Noguera.

AGERATUM, or Maudlin, in botany, a genus of the ſyngeneſia polygamia æqualis claſs. The receptacle is naked; the pappus has five ariſtæ or auns; the calix is oblong; and the ſtylus a little longer than the flower. There are three ſpecies of the ageratum, *viz.* the conyzoides, the ciliare, and the altiſſimum, all natives of America.

AGERATUS *lapis*, a ſtone uſed by the ancients in dying and dreſſing leather.

AGERIUM. See Agistment.

AGGA, or Agonna, a Britiſh ſettlement on the gold-coaſt of Guiney. It is ſituated under the meridian of London, in 6 degrees of N. lat.

Agger, in the ancient military art, a bank or rampart, compoſed of various materials, as earth, boughs of trees, *&c.*

The agger of the ancients was of the ſame nature with what the moderns call *lines*.

AGGERHUYS, a city of Norway, capital of the province of the ſame name. It is ſubject to Denmark, and ſituated in 28. 35. E. long. and 59. 30. N. lat.

AGGIA-SARAI, a town ſituated on the ſhore of the Caſpian ſea, between Turkeſtan and the country of Bulgar.

AGGLUTINANTS, in pharmacy, medicines of a glutinous or viſcid nature, given with a view to ſtrengthen the ſolids.

Agglutinants, among ſurgeons. See Vulneraries.

AGGLUTINATION, in a general ſenſe, denotes the joining two or more things together, by means of a a proper glue or cement.

Agglutination, among phyſicians, the adherence of new ſubſtance, or the giving a glutinous quality to the animal fluids.

Agglutination, is alſo a term uſed by aſtronomers to denote the meeting of two or more ſtars in the ſame part of the zodiac, or the ſeeming coalition of ſeveral ſtars.

AGGRAVATION, a term uſed to denote whatever heightens a crime, or renders it more black.

AGGREGATE, in a general ſenſe, denotes the ſum of ſeveral things added together, or the collection of them into one whole. Thus, a houſe is an aggregate of ſtones, wood, mortar, *&c.* It differs from a mixed or compound, inaſmuch as the union in theſe laſt is more intimate than between the parts of an aggregate. See Chemistry, *Of mixts*.

AGGRESSOR, among lawyers, denotes the perſon who began a quarrel, or made the firſt aſſault.

AGHER, Acher, or Augher, a town of Ireland, which ſends two members to parliament. It is ſituated in the ſouthern part of Ulſter, not far from Clogher.

AGHRIM, a town of Ireland, in the county of Wicklow, and province of Leinſter, ſituated about thirteen miles ſouth-weſt of Wicklow.

AGIADES, in the Turkiſh armies, a kind of pioneers employed in fortifying camps, and the like offices.

AGIASMA. See Hagiasma.

AGIGENSALON, a town of Turkey, upon the road from Conſtantinople to Iſpahan, about a day's journey from the city of Tocia.

AGILD, or Agilde, in old law-books, denotes a perſon of ſo little account, that whoever killed him was liable to no fine or other puniſhment.

AGILITY, an aptitude of the ſeveral parts of the body to motion; or it may be defined, the art or talent of making the beſt uſe of our ſtrength.

AGILLARIUS, in old law-books. See Hayward.

AGINCOURT, a village of the French Netherlands; famous on account of the victory obtained by Henry V. of England over the French, in 1415.

AGIO, in commerce, a term chiefly uſed in Holland and at Venice, where it denotes the difference between the value of bank-ſtock and the current coin.

Agio *of aſſurance*, the ſame with what we call *policy of aſſurance*. See Policy *of aſſurance*.

AGIST. See the next article.

AGISTMENT, Agistage, or Agistation, in law, the taking in other people's cattle to graze at ſo much *per* week. It is alſo uſed in a metaphorical ſenſe, for any tax, burden, or charge; thus, the tax levied for repairing the banks of Romney marſh was called *agiſtamentum*.

AGISTOR, or Agistator, an officer belonging to foreſts, who has the care of cattle taken in to be grazed, and levies the moneys due on that account.

AGISTALIA *animalium in foreſta*, in old law-books, ſignifies the drift of cattle or beaſts in a foreſt.

AGITATION, the act of ſhaking a body, or toſſing it backwards and forewards.

AGITATOR, in antiquity, a term ſometimes uſed for a charioteer, eſpecially thoſe who drove in the circus at the curule games.

AGITATORS, in the Engliſh hiſtory, certain officers ſet up by the army, in 1647, to take care of its intereſts.

Cromwell joined the agitators, only with a view to ſerve his own ends; which being once accompliſhed, he found means to get them aboliſhed.

AGLA, or Aqula, a town of Africa in the kingdom of Fez, ſituated not far from the river Guarga.

AGLAOPHOTIS, in botany, an obſolete name of the pæonia. See Pæonia.

AGLECTS, Aglets, or Agleeds, in botany. See Antheræ.

AGLIA, in geography, a fortreſs of Peidmont, with the title of marquiſate, ſituated in the Canavois.

AGMOT, or Agmet, the name of a town, diſtrict, and river of Africa, in the empire of Morocco.

AGMEN, in the Roman art of war, denoted an army, or

or rather a part of it, in march: Thus we read of the *primum agmen*, or van-guard; *medium agmen*, or main body; and the *poſtremum agmen*, or rear-guard.

AGMONDESHAM, in geography. See AMERSHAM.

AGNABAT, a town of Tranſylvania, ſubject to the houſe of Auſtria, ſituated about ten miles north-eaſt of Hermanſtadt.

AGNANO, a lake of the kingdom of Naples, in the province of Lavoro.

AGNANTHUS, in botany, a ſynonime of the cornutia. See CORNUTIA.

AGNATE, in Scots law, any male relation by the father's ſide. See LAW, title, *Minors, and their tutors and curators*.

AGNEL, an ancient French coin, otherwiſe called *mouton d'or*. See MOUTON *d'or*.

AGNELET, an ancient French coin, worth about twenty ſols.

AGNO, a river of Naples, which, taking its riſe in the mountainous parts of Terra di Lavoro, waſhes the town of Acerra, and, paſſing between Capua and Averſa, falls into the Mediterranean, about ſeven miles N. of Puzzoli.

AGNOETÆ, in church-hiſtory, a ſect of heretics, ſo called on account of their maintaining, that Chriſt, with reſpect to his human nature, was ignorant of many things, and particularly of the day of judgment, an opinion which they built upon the text, Mark xiii. 32.

AGNOMEN, in Roman antiquity, a kind of fourth or honorary name, given to a perſon on account of ſome extraordinary action, virtue, or other accompliſhment. Thus, the agnomen *Africanus* was beſtowed upon Publius Cornelius Scipio, on account of his great atchievements in Africa.

AGNON, a ſmall river of Bourgogne in France, otherwiſe called *Ignon*.

AGNONE, a city of the kingdom of Naples, in the province of the Hither Abruzzo, called by ſome *Anclone*.

AGNOS, in ichthyology, an obſolete name of the uranoſcopus. See URANOSCOPUS.

AGNUS, or LAMB, in zoology, the young of the ovis or ſheep. See OVIS.

AGNUS *caſtus*, in botany, the trivial name of a ſpecies of the vitex. See VITEX.

AGNUS *Dei*, in the church of Rome, a cake of wax ſtamped with the figure of a lamb ſupporting a croſs.

Theſe being conſecrated by the pope with great ſolemnity, and diſtributed among the people, are ſuppoſed to have great virtues; as, to preſerve thoſe who carry them worthily, and with faith, from all manner of accidents; to expel evil ſpirits, *&c.* It is alſo a popular name for that part of the maſs, where the prieſt ſtrikes his breaſt thrice, and ſays the prayer beginning with the words *Agnus Dei*.

AGNUS *Scythicus*, in botany, the name of a fictitious plant ſaid to grow in Tartary, reſembling a lamb.

AGOBEL, a ſmall town of Africa, in the empire of Morocco, and province of Hea.

AGOGA, among ancient naturaliſts, denoted a drain for carrying off water from a mine.

AGOGE, among ancient muſicians, a ſpecies of modulation, wherein the notes proceeded by contiguous degrees.

AGON, in the public games of the ancients, a term uſed indifferently for any conteſt or diſpute, whether reſpecting bodily exerciſes, or accompliſhments of the mind. Thus poets, muſicians, *&c.* had their agones, as well as the athletæ. It was alſo uſed for one of the miniſters employed in the heathen ſacrifices, whoſe buſineſs it was to ſtrike the victim.

AGON, in Roman antiquity, a place near the Tiber, where the curule games were celebrated, otherwiſe called *circus Flammineus*.

AGON, among phyſicians. See AGONY.

AGONALIS, in Roman antiquity. See SALII.

AGONALIA, in Roman antiquity, feſtivals celebrated in honour of Janus, or of the god Agonius, whom the Romans invoked before undertaking any affair of importance.

AGONENSES. See SALII.

AGONISMA, in antiquity, denotes the prize given to the victor in any combat or diſpute.

AGONISTARCHA, in antiquity, the officer who directed the preparatory exerciſes of the athletæ; tho' ſome make him the ſame with the agonotheta. See AGONOTHETA.

AGONISTICA, a term uſed to denote the ſcience of whatever belonged to the agones, or public exerciſes of the ancients.

AGONISTICI, in church-hiſtory, a name given by Donatus to ſuch of his diſciples as he ſent to fairs, markets, and other public places, to propagate his doctrine.

AGONISTICON, a term uſed by phyſicians for cold water, as being ſuppoſed to combat the febrile heat.

AGONIUM, in Roman antiquity, was uſed for the day on which the *rex ſacrorum* ſacrificed a victim, as well as for the place where the games were celebrated, otherwiſe called *Agon*.

AGONOTHETA, or AGONOTHETES, in Grecian antiquity, was the preſident or ſuperintendant of the ſacred games; who not only defrayed the expences attending them, but inſpected the manners and diſcipline of the athletæ, and adjudged the prizes to the victors.

AGONUS, in ichthyology, a ſynonyme of the clupea aloſa. See CLUPEA.

AGONY, any extreme pain. It is alſo uſed for the pangs of death.

AGONYCLITÆ, or AGONYCLITES, in church-hiſtory, a ſect of chriſtians, in the ſeventh century, who prayed always ſtanding, as thinking it unlawful to kneel.

AGORÆUS, in heathen antiquity, an appellation given to ſuch deities as had ſtatues in the market-places; particularly Mercury, whoſe ſtatue was to be ſeen in almoſt every public place.

AGORANOMUS, in Grecian antiquity, a magiſtrate of Athens, who had the regulation of weights and meaſures, of the prices of proviſions, *&c.*

AGOUGES, a river of France, which, after watering part of Auvergne, falls into the Sible.

AGRA, a city of the Hither India, and capital of a kingdom of the same name. It is situated on the river Jemma, and is a large, populous, and beautiful city, where the Mogul frequently resides.

AGRAM, a city and bishop's see of Hungary, situated near the frontiers of Carniola.

AGRARIAN *laws*, among the Romans, those relating to the division and distribution of lands; of which there were a great number; but that called the *Agrarian law*, by way of eminence, was published by Spurius Cassius, about the year of Rome 268, for dividing the conquered lands equally among all the citizens, and limiting the number of acres which each citizen might enjoy.

AGRARIUM. See AGISTMENT.

AGREDA, a town of Spain, in old Castile, near the frontiers of Arragon, and about three leagues south-west of Taracon.

AGREDA, is also a town of South America, situated at the foot of the mountains in the kingdom of Popaian.

AGREEMENT, in law, signifies the consent of several persons to any thing done or to be done.

AGRESSES, or OGRESSES, in heraldry, a term sometimes used for pellets. See PELLETS.

AGRESTÆ, among physicians, denotes unripe grapes, said to be of a cooling nature.

AGRI, or ACRI, a river of the kingdom of Naples, which arising in the Apennine mountains, not far from Marsico Nuovo, falls into the gulph of Tarento.

AGRIA, a town and river of Upper Hungary. The town is a bishop's see, and situated about thirty-five miles N. E. of Buda.

A G R I C U L T U R E.

AGRICULTURE is the art of assisting the earth, by means of culture, manure, *&c.* to bring forth plants in greater quantity, and likewise of a larger size and better quality, than it would produce without these assistances.

AGRICULTURE is an art of such consequence to mankind, that their very existence, especially in a state of society, depends upon it. A compendious view, therefore, of every material discovery that hath hitherto been made in this art, must be useful both to the farmer and philosopher.

To accomplish this end with the greater perspicuity, the subject shall be divided into two parts. Under the first, Vegetation, and the Structure of Plants, shall be considered. The second will contain the various Operations upon the Soil, in order to prepare it for the reception and nourishment of plants.

For the ease of the reader, each of these parts shall be subdivided into a number of sections.

P A R T I.

Of Vegetation, and the Structure of Plants.

THE vegetation and œconomy of plants is one of those subjects in which our knowledge is extremely circumscribed. Many hypotheses have been invented; as many have been, or may easily be, refuted. Hypotheses in matters that evidently exceed our powers do much hurt: But they are likewise of some use. They incite to further inquiries; and these inquiries are carried on with greater spirit, because they are intended for the purpose of confuting. It is true this spirit is not the most friendly to impartial observation; but it makes us more indefatigable in our researches.

Retailing theories is no part of our plan. A total inattention to the structure and œconomy of plants is the chief reason of the small progress that has been made in the principles of vegetation, and of the instability and fluctuation of our theories concerning it.

To recall the attention of philosophers and cultivators, to the only source from which any solid theory can ever be formed on this subject, we shall give a short description of the structure of plants, beginning with the seed, and tracing its progress and evolution to a state of maturity.

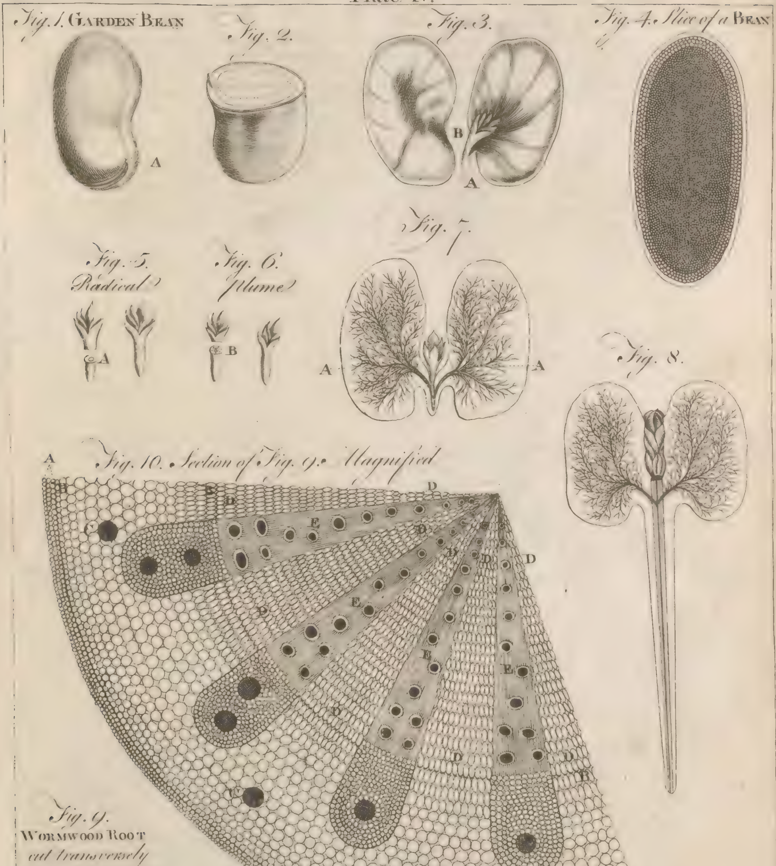
SECT. I. *Of Seeds.*

THE seeds of plants are of various figures and sizes. Most of them are divided into two lobes; though some, as those of the cress-kind, have six; and others, as the grains of corn, are not divided, but intire.

But, as the essential properties of all seeds are the same, when considered with regard to the principles of vegetation, our particular descriptions shall be limited to one seed, *viz.* the great garden-bean. Neither is the choice of this seed altogether arbitrary; for, after it begins to vegetate, its parts are more conspicuous than many others, and consequently better calculated for investigation.

This seed is covered with two coats or membranes. The

Plate IV.



J. Bell Sculp.

The outer coat is extremely thin, and full of pores; but may be eafily feparated from the inner one, (which is much thicker), after the bean has been boiled, or lain a few days in the foil. At the thick end of the bean, there is a fmall hole vifible to the naked eye, immediately over the radicle or future root, that it may have a free paffage into the foil. Plate IV. fig. 1. A. When thefe coats are taken off, the body of the feed appears, which is divided into two fmooth portions or lobes. The fmoothnefs of the lobes is owing to a thin film or cuticle with which they are covered.

At the bafis of the bean is placed the radicle or future root, Plate IV. fig. 3. A. The trunk of the radicle, juft as it enters into the body of the feed, divides into two capital branches, one of which is inferted into each lobe, and fends off fmaller ones in all directions through the whole fubftance of the lobes, Plate IV. fig. 7. A A. Thefe ramifications become fo extremely minute towards the edges of the lobes, that they require the fineft glaffes to render them vifible. To thefe ramifications Grew and Malpighius have given the name of *feminal root;* becaufe, by means of it, the radicle and plume, before they are expanded, derive their principal nourifhment.

The plume, bud, or germ, Plate IV. fig. 3. is inclofed in two fmall correfponding cavities in each lobe. Its colour and confiftence is much the fame with thofe of the radicle, of which it is only a continuation; but having a quite contrary direction: For the radicle defcends into the earth, and divides into a great number of fmaller branches or filaments; but the plume afcends into the open air, and unfolds itfelf into all the beautiful variety of ftem, branches, leaves, flowers, fruit, *&c.* The plume in corn fhoots from the fmaller end of the grain, and, among maltfters, goes by the name of *acrofpire.*

The next thing to be taken notice of is the fubftance, or parenchymatous part of the lobes. This is not a mere concreted juice, but is curioufly organifed, and confifts of a vaft number of fmall bladders refembling thofe in the pith of trees, Plate IV. fig. 4.

Befides the coats, cuticle, and parenchymatous parts, there is a fubftance perfectly diftinct from thefe, diftributed in different proportions through the radicle, plume, and lobes. This inner fubftance appears very plainly in a tranfverfe fection of the radicle or plume. Towards the extremity of the radicle, it is one entire trunk; but higher up, it divides into three branches; the middle one runs directly up to the plume, and the other two pafs into the lobes on each fide, and fpread out into a great variety of fmall branches through the whole body of the lobes, Plate IV. fig. 7. This fubftance is very properly termed the *feminal root:* for when the feed is fown, the moifture is firft abforbed by the outer coats, which are every where furnifhed with fap and air-veffels; from thefe it is conveyed to the cuticle; from the cuticle it proceeds to the pulpy part of the lobes; when it has got thus far, it is taken up by the mouths of the fmall branches of the feminal root, and paffes from one branch into another, till it is all collected into the main trunk, which communicates both with the plume and radicle, the two principal involved organs of the future plant. After this the fap, or vegetable food, runs in two oppofite directions; part of it afcends into the plume, and promotes the growth and expanfion of that organ; and part of it defcends into the radicle, for nourifhing and evolving the root and its various filaments. Thus the plume and radicle continue their progrefs in oppofite directions, till the plant arrives at maturity.

It is here worth remarking, that every plant is really poffeffed of two roots, both of which are contained in the feed. The plume and radicle, when the feed is firft depofited in the earth, derive their nourifhment from the feminal root: but, afterwards, when the radicle begins to fhoot out its filaments, and to abforb fome moifture, not, however, in a fufficient quantity to fupply the exigencies of the plume, the two lobes, or main body of the feed, rife along with the plume, affume the appearance of two leaves, refembling the lobes of the feed in fize and fhape, but having no refemblance to thofe of the plume, for which reafon they have got the name of *diffimilar leaves.*

Thefe diffimilar leaves defend the young plume from the injuries of the weather, and at the fame time, by abforbing dew, air, *&c.* affift the tender radicle in nourifhing the plume, with which they have ftill a connection by means of the feminal root above defcribed. But, when the radicle or fecond root has defcended deep enough into the earth, and has acquired a fufficient number of filaments or branches for abforbing as much aliment as is proper for the growth of the plume; then the feminal, or diffimilar leaves, their utility being entirely fuperfeded, begin to decay and fall off.

PLATE IV. *Fig.* 1. A, The foramen, or hole in the bean through which the radicle fhoots into the foil.

Fig. 2. A tranfverfe fection of the bean; the dotes being the branches of the feminal root.

Fig. 3. A, The radicle.
B, The plume or bud.

Fig. 4. A, A longitudinal fection of one of the lobes of the bean a little magnified, to fhow the fmall bladders of which the pulpy or parenchymatous part is compofed.

Fig. 5, 6. A, A tranfverfe fection of the radicle.
B, A tranfverfe fection of the plume, fhowing the organs or veffels of the feminal root.

Fig. 7. A, A view of the feminal root branched out upon the lobes.

Fig. 8. The appearance of the radicle, plume, and feminal root, when a little further advanced in growth.

Having thus briefly defcribed the feed, and traced its evolution into three principal organic parts, *viz.* the plume, radicle, and feminal leaves, we fhall next take an anatomical view of the root, trunk, leaves, *&c.*

SECT. II. *Of the Root.*

In examining the root of plants, the firſt thing that preſents itſelf is the ſkin, which is of various colours in different plants. Every root, after it has arrived at a certain age, has a double ſkin. The firſt is coeval with the other parts, and exiſts in the ſeed: but afterwards there is a ring ſent off from the bark, and forms a ſecond ſkin; *e. g.* in the root of the dandelion, towards the end of May, the original or outer ſkin appears ſhriveled, and is eaſily ſeparated from the new one, which is freſher, and adheres more firmly to the bark. Perennial plants are ſupplied in this manner with a new ſkin every year; the outer one always falls off in the autumn or winter, and a new one is formed from the bark in the ſucceeding ſpring. The ſkin has numerous cells or veſſels, and is a continuation of the parenchymatous part of the radicle. However, it does not conſiſt ſolely of parenchyma; for the microſcope ſhews that there are many tubular lignous veſſels interſperſed through it.

When the ſkin is removed, the true cortical ſubſtance or bark appears, which is alſo a continuation of the parenchymatous part of the radicle, but greatly augmented. The bark is of very different ſizes. In moſt trees, it is exceeding thin in proportion to the wood and pith. On the other hand, in carrots, it is almoſt one half of the ſemidiameter of the root; and, in dandelion, it is nearly twice as thick as the woody part.

1. The Bark is compoſed of two ſubſtances; the parenchyma, or pulp, which is the principal part; and a few woody fibres. The parenchyma is exceedingly porous, and has a great reſemblance to a ſpunge; for it ſhrivels conſiderably when dried, and dilates to its former dimenſions when infuſed in water. Theſe pores or veſſels are not pervious ſo as to communicate with each other, but conſiſt of diſtinct little cells or bladders, ſcarcely viſible without the aſſiſtance of the microſcope. In all roots, theſe cells are conſtantly filled with a thin watery liquor. They are generally of a ſpherical figure; though in ſome roots, as the bugloſs and dandelion, they are oblong. In many roots, as the horſe-raddiſh, peony, aſparagus, potatoe, *&c.* the parenchyma is of one uniform ſtructure. But in others it is more diverſified, and puts on the ſhape of rays running from the centre towards the circumference of the bark. Theſe rays ſometimes run quite through the bark, as in lovage; and ſometimes advance towards the middle of it, as in melilot and moſt of the leguminous and umbelliferous plants. Theſe rays generally ſtand at an equal diſtance from each other in the ſame plant; but the diſtance varies greatly in different plants. Neither are they of equal ſizes: In carrot they are exceedingly ſmall, and ſcarcely diſcernible; in melilot and cherval, they are thicker. They are likewiſe more numerous in ſome plants than in others. Sometimes they are of the ſame thickneſs from one edge of the bark to the other; and ſome grow wider as they approach towards the ſkin. The veſſels with which theſe rays are amply furniſhed, are ſuppoſed to be air-veſſels, becauſe they are always found to be dry, and not ſo tranſparent as the veſſels which evidently contain the ſap.

In all roots, there are lignous veſſels diſperſed in different proportions through the parenchyma of the bark. Theſe lignous veſſels run longitudinally through the bark in the form of ſmall threads, which are tubular, as is evident from the riſing of the ſap in them when a root is cut tranſverſely. Theſe lignous ſap-veſſels do not run in direct lines through the bark, but, at ſmall diſtances, incline towards one another in ſuch a manner, that they appear to the naked eye to be inoſculated; but the microſcope diſcovers them to be only contiguous, and braced together by the parenchyma. Theſe braces or coarctations are very various both in ſize and number in different roots; but in all plants they are moſt numerous towards the inner edge of the bark. Neither are theſe veſſels ſingle tubes, but, like the nerves in animals, are bundles of twenty or thirty ſmall contiguous cylindrical tubes, which uniformly run from the extremity of the root, without ſending off any branches, or ſuffering any change in their ſize or ſhape.

In ſome roots, as parſnip, eſpecially in the ring next the inner extremity of the bark, theſe veſſels contain a kind of lymph, which is ſweeter than the ſap contained in the bladders of the parenchyma. From this circumſtance they have got the name of *lymph-ducts.*

Theſe lymph-ducts ſometimes yield a mucilaginous lymph, as in the comphrey; and ſometimes a white milky glutinous lymph, as in the angelica, ſonchus, burdock, ſcorzonera, dandelion, *&c.* The lymph-ducts are ſuppoſed to be the veſſels from which the gums and balſams are ſecerned. The lymph of fennil, when expoſed to the air, turns into a clear tranſparent balſam; and that of the ſcorzonera, dandelion, *&c.* condenſes into a gum.

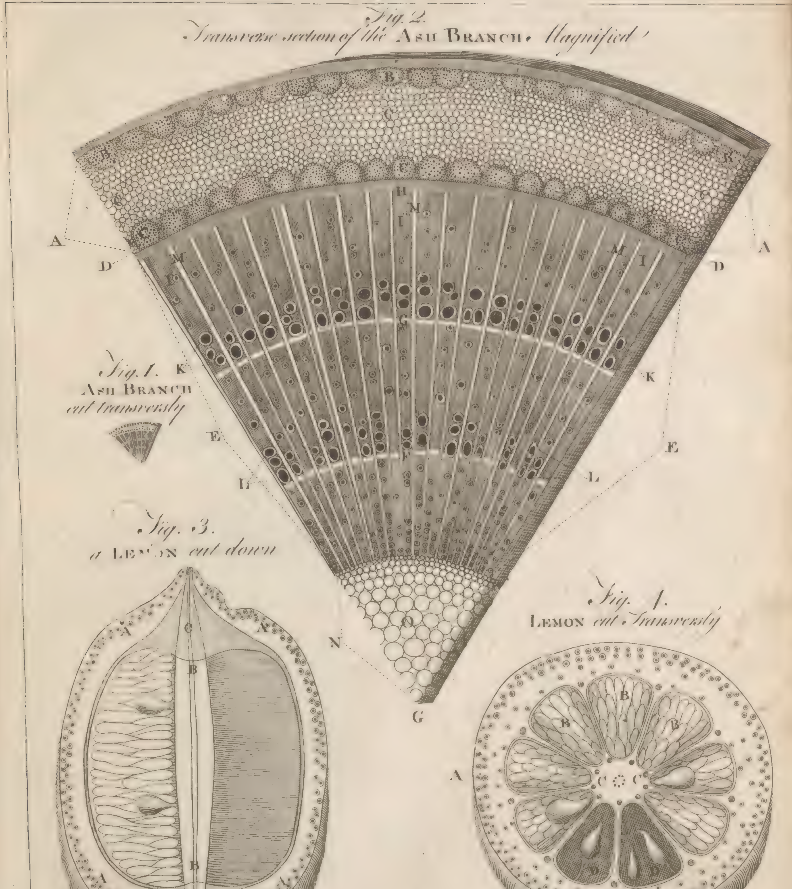
The ſituation of the veſſels is various. In ſome plants, they ſtand in a ring or circle at the inner edge of the bark, as in aſparagus; in others, they appear in lines, or rays, as in borage; in the parſnip, and ſeveral other plants, they are moſt conſpicuous toward the outer edge of the bark; and in the dandelion, they are diſpoſed in the form of concentric circles.

2. The Wood of roots is that part which appears after the bark is taken off, and is firmer and leſs porous than the bark or pith. It conſiſts of two diſtinct ſubſtances, *viz.* the pulpy, or parenchymatous, and the lignous. The wood is connected to the bark by large portions of the bark inſerted into it. Theſe inſertions are moſtly in the form of rays, tending to the centre of the pith, which are eaſily diſcernible by the eye in a tranſverſe ſection of moſt roots. Theſe inſertions, like the bark, conſiſt of many veſſels, moſtly of a round or oval figure.

The lignous veſſels are generally diſpoſed in collateral rows running longitudinally through the root. Some of theſe contain air, and others ſap. The air-veſſels are ſo called, becauſe they contain no liquor. Theſe air-veſſels are diſtinguiſhed by being whiter than the others.

3. The Pith is the centrical part of the root. Some roots have no pith, as the ſtramonium, nicotiana, *&c.* others have little or none at the extremities of the roots, but have a conſiderable quantity of it near the top. The pith, like every other part of a plant, is derived from

Plate V.



A Bell Sculp.t

from the ſeed: But in ſome it is more immediately derived from the bark. For the inſertions of the bark running in betwixt the rays of the wood, meet in the centre, and conſtitute the pith. It is owing to this circumſtance, that among roots which have no pith in their lower parts, they are amply provided with it towards the top, as in columbine, lovage, *&c.*

The bladders of the pith are of very different ſizes, and generally of a circular figure. Their poſition is more uniform than in the bark. Their ſides are not mere films, but a compoſition of ſmall fibres or threads; which gives the pith, when viewed with a microſcope, the appearance of a piece of fine gauze, or net-work.

We ſhall conclude the deſcription of roots, with obſerving, that their whole ſubſtance is nothing but a congeries of tubes and fibres, adapted by nature for the abſorption of nouriſhment, and of courſe the extenſion and augmentation of their parts.

Plate IV. *Fig.* 9. A tranſverſe ſection of the root of wormwood, as it appears to the naked eye.

Fig. 10. A ſection of fig. 9. magnified.
A A, The ſkin, with its veſſels.
B B B B, The bark. The round holes, C C C, *&c.* are the lymph-ducts of the bark. All the other holes are little cells and ſap-veſſels.
D D D, Parenchymatous inſertions from the bark, with the cells, *&c.*
E E E E, The rays of the wood, in which the holes are the air-veſſels.

N. B. This root has no pith.

Sect. III. *Of the Trunk, Stalk, or Stem.*

In deſcribing the trunks of plants, it is neceſſary to premiſe, that whatever is ſaid with regard to them, applies equally to the branches,

The trunk, like the root, conſiſts of three parts, *viz.* the bark, wood, and pith. Theſe parts, though ſubſtantially the ſame in the trunk as in the root, are in many caſes very different in their texture and appearance.

1. The ſkin of the bark is compoſed of very minute bladders, interſperſed with longitudinal woody fibres, as in the nettle, thiſtle, and moſt herbs. The outſide of the ſkin is viſibly porous in ſome plants, particularly the cane.

The principal body of the bark is compoſed of pulp or parenchyma, and innumerable veſſels much larger than thoſe of the ſkin. The texture of the pulpy part, tho' the ſame ſubſtance with the parenchyma in roots, yet ſeldom appears in the form of rays running towards the pith; and when theſe rays do appear, they do not extend above half way to the circumference. The veſſels of the bark are very differently ſituated, and deſtined for various purpoſes in different plants. For example, in the bark of the Pine, the inmoſt are lymph-ducts, and exceedingly ſmall; the outmoſt are gum or reſiniferous veſſels, deſtined for the ſecretion of turpentine; and are ſo large, as to be diſtinctly viſible to the naked eye.

2. The Wood lies betwixt the bark and pith, and conſiſts of two parts, *viz.* a parenchymatous, and lignous. In all trees, the parenchymatous part of the wood, though much diverſified as to ſize and conſiſtence, is uniformly diſpoſed in diametrical rays, or inſertions running betwixt ſimilar rays of the lignous part.

The true wood is nothing but a congeries of old dried lymph-ducts. Between the bark and the wood a new ring of theſe ducts is formed every year, which gradually looſes its ſoftneſs as the cold ſeaſon approaches, and, towards the middle of winter, is condenſed into a ſolid ring of wood. Theſe annual rings, which are diſtinctly viſible in moſt trees when cut through, ſerve as natural marks to diſtinguiſh their age. Plate V. fig. 1, 2. The rings of one year are ſometimes larger, ſometimes leſs, than thoſe of another, probably owing to the favourableneſs or unfavourableneſs of the ſeaſon.

3. The Pith, though of a different texture, is exactly of the ſame ſubſtance with the parenchyma of the bark, and the inſertions of the wood. The quantity of pith is various in different plants. Inſtead of being increaſed every year like the wood, it is annually diminiſhed, its veſſels drying up, and aſſuming the appearance and ſtructure of wood; in ſo much that in old trees there is ſcarce ſuch a thing as pith to be diſcerned.

A ring of ſap-veſſels are uſually placed at the outer edge of the pith, next the wood. In the pine, fig, and walnut, they are very large. The parenchyma of the pith, is compoſed of ſmall cells or bladders, of the ſame kind with thoſe of the bark, only of a larger ſize. The general figure of theſe bladders is circular; though in ſome plants, as the thiſtle, and borage, they are angular. Though the pith is originally one connected chain of bladders; yet as the plant grows old, they ſhrivel, and open in different directions. In the walnut, after a certain age, it appears in the form of a regular tranſverſe hollow diviſion. In ſome plants, it is altogether wanting; in others, as the ſonchus, nettle, *&c.* there is only a tranſverſe partition of it at every joint. Many other varieties might be mentioned; but theſe muſt be left to the obſervation of the reader.

Plate V. *Fig.* 1. A tranſverſe ſection of a branch of aſh, as it appears to the eye.

Fig. 2. The ſame ſection magnified.
A A, The bark.
B B B, An arched ring of ſap-veſſels next the ſkin.
C C C, The parenchyma of the bark with its cells, and another arched ring of ſap-veſſels.
D D, A circular line of lymph-ducts immediately below the above arched ring.
E E, The wood.
F, The firſt year's growth.
G, The ſecond.

H, The

Plate V. *Fig.* 2. H, The third year's growth.
I I I, The true wood.
K K, The great air-veſſels.
L L, The leſſer ones.
M M M, The parenchymatous inſertions of the bark repreſented by the white rays.
N, O, The pith, with its bladders or cells.

Sect. IV. *Of the Leaves.*

The leaves of plants conſiſt of the ſame ſubſtance with that of the trunk. They are full of nerves, or woody portions, running in all directions, and branching out into innumerable ſmall threads, interwoven with the Parenchyma like fine lace or gauze.

The ſkin of the leaf, like that of an animal, is full of pores, which both ſerve for perſpiration, and for the abſorption of dews, air, *&c.* Theſe pores, or orifices, differ both in ſhape and magnitude in different plants, which is the cauſe of that variety of texture or grain peculiar to every plant.

The pulpy or parenchymatous part, conſiſts of very minute fibres, wound up into ſmall cells or bladders. Theſe cells are of various ſizes in the ſame leaf.

All leaves, of whatever figure, have a marginal fibre, by which all the reſt are bounded. The particular ſhape of this fibre determines the figure of the leaf.

The veſſels of leaves have the appearance of inoſculating; but, when examined by the microſcope, they are found only to be interwoven, or laid along each other.

What is called air-veſſels, or thoſe which carry no ſap, are viſible even to the naked eye in ſome leaves. When a leaf is ſlowly broke, they appear like ſmall woolly fibres, connected to both ends of the broken piece.

Plate VI. *Fig.* 1. The appearance of the air-veſſels to the eye, in a vine leaf drawn gently aſunder.
Fig 2. A ſmall piece cut off that leaf.
Fig. 3. The ſame piece magnified, in which the veſſels have the appearance of a ſcrew.
Fig. 4. The appearance of theſe veſſels as they exiſt in the leaf before they are ſtretched out.

Sect. V. *Of the Flower.*

It is needleſs here to mention any thing of the texture, or of the veſſels, *&c.* of flowers, as they are pretty ſimilar to thoſe of the leaf. It would alſo be foreign to our preſent purpoſe, to take any notice of the characters and diſtinctions of flowers. Theſe belong to the ſcience of Botany, to which the reader is referred.

There is one curious fact, however, which muſt not be omitted, *viz.* That every flower is perfectly formed in all its parts many months before it appears outwardly; that is, the flowers which appear this year, are not, properly ſpeaking, the flowers of this year, but of the laſt. For example, mezereon generally flowers in January; but theſe flowers were completely formed in the month of Auguſt preceeding. Of this fact any one may ſatisfy himſelf by ſeparating the coats of a tulip root about the beginning of September; and he will find that the two innermoſt form a kind of cell, in the centre of which ſtands the young flower, which is not to make its appearance till the following April or May.

Plate VI. *Fig.* 5. Exhibits a view of the tulip-root when diſſected in September, with the young flower towards the bottom.

Sect. VI. *Of the Fruit.*

In deſcribing the ſtructure of fruits, a few examples ſhall be taken from ſuch as are moſt generally known.

1. A Pear, beſides the ſkin, which is a production of the ſkin of the bark, conſiſts of a double parenchyma or pulp, ſap, and air-veſſels, calculary, and acetary.

The outer parenchyma is the ſame ſubſtance continued from the bark, only its bladders are larger and more ſucculent.

It is every where interſperſed with ſmall globules or grains, and the bladders reſpect theſe grains as a kind of centres, every grain being the centre of a number of bladders. The ſap and air-veſſels in this pulp are extremely ſmall.

Next the core is the inner pulp or parenchyma, which conſiſts of bladders of the ſame kind with the outer, only larger and more oblong, correſponding to thoſe of the pulp, from which it ſeems to be derived. This inner pulp is much ſourer than the other, and has none of the ſmall grains interſperſed through it; and hence it has got the name of *acetary*.

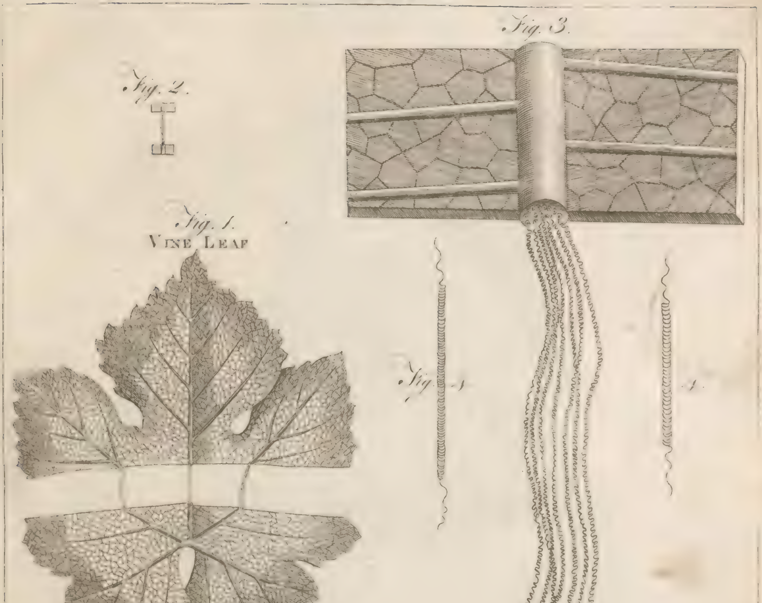
Between the acetary and outer pulp, the globules or grains begin to grow larger, and gradually unite into a hard ſtony body, eſpecially towards the corculum, or ſtool of the fruit; and from this circumſtance it has been called the *calculary*.

Theſe grains are not derived from any of the organical parts of the tree, but ſeem rather to be a kind of concretions precipitated from the ſap, ſimilar to the precipitations from wine, urine, and other liquors.

The core is a roundiſh cavity in the centre of the pear, lined with a hard woody membrane, in which the ſeed is incloſed. At the bottom of the core there is a ſmall duct or canal, which runs up to the top of the pear; this canal allows the air to get into the core, for the purpoſe of drying and ripening the ſeeds.

Plate VII. *Fig.* 1. A tranſverſe ſection of a pear, as it appears to the naked eye.
A, The ſkin, and a ring of ſap-veſſels
B, The outer parenchyma, or pulp,

Plate VI.



Bell sculp

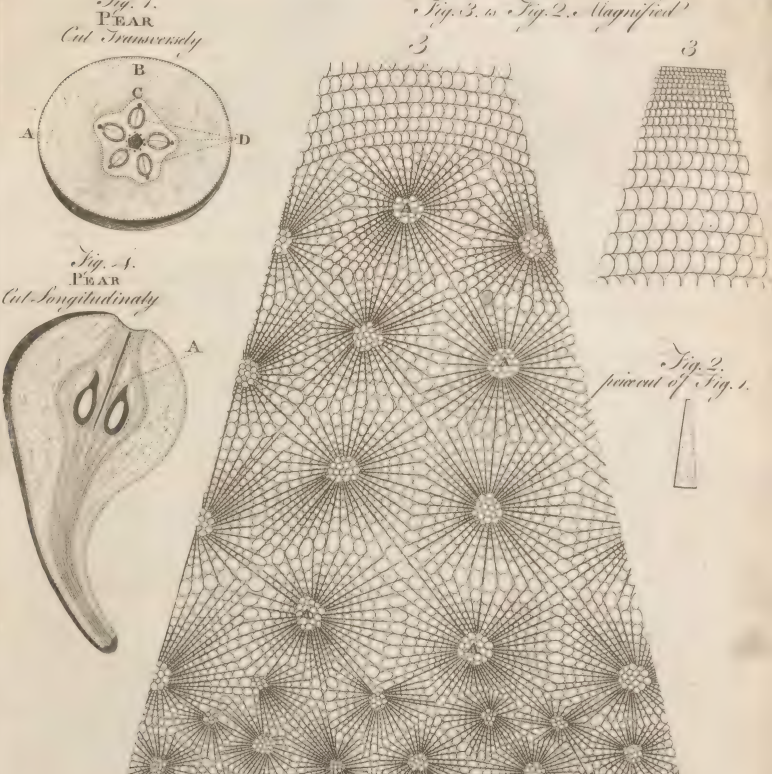


Fig. 1.
PEAR
Cut Transversely
B
C
A
D
Fig. 4.
PEAR
Cut Longitudinaly
A
Fig. 3. is Fig. 2. Magnified
3
3
Fig. 2.
peice cut of Fig. 1.

Bell Sculp.

pulp, with its vessels, and lignous fibres interspersed.

PLATE VII. *Fig.* 1. C, The inner parenchyma, or acetary, with its vessels, which are larger than the outer one.
D, The core and seeds.
Fig. 2. A piece cut off fig. 1.
Fig. 3. Is fig. 2. magnified.
A A A, The small grains or globules with the vessels radiated from them.
Fig. 4. A longitudinal section of the pear, shewing a different view of the same parts with those of fig. 1.
A, The channel, or duct, which runs from the top of the pear to the bottom of the core.

2. In a LEMON, the parenchyma appears in three different forms. The parenchyma of the rind is of a coarse texture, being composed of thick fibres, woven into large bladders. Those nearest the surface contain the essential oil of the fruit, which bursts into a flame when the skin is squeezed over a candle. From this outmost parenchyma nine or ten insertions or lamellæ are produced, which run between as many portions of the pulp, and unite into one body in the centre of the fruit, which corresponds to the pith in trunks or roots. At the bottom and top of the lemon, this pith evidently joins with the rind, without the intervention of any lamellæ. This circumstance shows, that the pith and bark are actually connected in the trunk and roots of plants, though it is difficult to demonstrate the connection, on account of the closeness of their texture, and the minuteness of their fibres. Many vessels are dispersed through the whole of this parenchyma; but the largest ones stand on the inner edge of the rind, and the outer edge of the pith, just at the two extremities of each lamella.

The second kind of parenchyma is placed between the rind and the pith, is divided into distinct bodies by the lamellæ; and each of these bodies forms a large bag.

These bags contain a third parenchyma, which is a cluster of smaller bags, distinct and unconnected with each other, having a small stalk by which they are fixed to the large bag. Within each of these small bags are many hundreds of bladders, composed of extremely minute fibres. These bladders contain the acid juice of the lemon.

From this short sketch of the structure and composition of vegetables, both the farmer and philosopher may draw very useful and important conclusions. Some of them will perhaps be taken notice of in the course of this treatise.

PLATE V. *Fig.* 3. A longitudinal section of a lemon.
A A A, The rind with the vessels that contain the essential oil.
B B, The substance corresponding to the pith, formed by the union of the lamellæ, or insertions.

PLATE V. *Fig.* 3. C C, Its continuation and connection with the rind, independent of the insertions.
Fig. 4. A transverse section of the lemon.
B B B, *&c.* The nine pulpy bags, or second parenchyma, placed between the rind and the pith; and the cluster of small bags, which contain the acid juice, inclosed in the large ones.
C C, The large vessels that surround the pith.
D D, Two of the large bags laid open, shewing the seeds, and their connection with the lamellæ or membranes which form the large bags.

SECT. VII. *Of the nature and motion of the Sap.*

THE vessels in the roots of plants absorb moisture from the earth, and convey it to the trunk, branches, leaves, *&c.* This juice, when it first enters into the root, is crude; but as it ascends into the other parts of the plant, it undergoes several changes, by means of the different configurations of the vessels peculiar to each part. Thus the leaves, flowers, fruit, and seed, have all something peculiar in the structure and arrangement of their vessels, which produces considerable changes in the nature of the sap. It is not known how these changes are produced: but how the stomachs of animals make chyle from animal and vegetable substances, or how urine, saliva, bile, *&c.* is secreted from the common mass of blood, is as little known. The sap likewise moves in a lateral or horizontal direction.

Philosophers are greatly divided about what they call the circulation of the sap. Some contend, that it returns to the root betwixt the bark and wood. But Hales, who has made many accurate experiments on the subject, has shown, that it does not circulate, but ascends and descends in the same vessels; that it ascends in hot weather, and descends in cold, like the spirits in a thermometer.

Vegetables begin to absorb sap about the beginning of Spring, and soon after shoot out their buds, leaves, and flowers.

When plants are in a state of vegetation, especially in hot weather, there is a great deal of superfluous sap absorbed; but the superfluous parts are carried off by transpiration. Every part of a plant transpires; but the greatest quantity passes by the leaves.

Some have assigned the transpiration of plants, as the cause of the motion of the sap. It is undoubtedly one cause of this motion; because, if the transpiration be stopped, at a time when all the vessels are full, the motion of the sap must stop of course. But then there is a previous and principal cause, *viz.* that power in the vessels,

ſels, whatever it is, that firſt puts the ſap in motion, before any tranſpiration has commenced.

Heat, moiſture, and air, are the three chief circumſtances that promote the aſcent of the ſap. Hence nothing is more favourable to vegetation than warm weather accompanied with rain: on the other hand, cold dry weather is its greateſt enemy. In a wet, cold ſeaſon, every thing rots; and in hot dry weather every thing is parched. But the circumſtances moſt favourable to vegetation are cloudy, hot weather, inclinable to thunder, ſucceeded by plentiful rains.

SECT. VIII. *Of the Food of Plants.*

IT is thought to be an important queſtion in agriculture, whether the ſeveral kinds of plants require the ſame, or different nouriſhment.

Upon a ſuperficial view of this queſtion, it would appear very improbable, that the ſame matter could nouriſh ſuch a variety of plants, differing ſo eſſentially in ſmell, taſte, figure, *&c.* Much, however, may depend upon the internal ſtructure and arrangement of the veſſels. One thing is certain, that if the veſſels in any plant be uncommonly ſmall, parts will be rejected by that plant which would be abſorbed by one whoſe veſſels are larger. Nay, changes may be made in the crude homogeneous nouriſhment, by a ſmall difference in the figure or action of the veſſels.

It is given out as a fact, by writers on this ſubject, that one plant will ſtarve another, by robbing it of its nouriſhment. This does not ſeem to affect either ſide of the queſtion; for it may ſtarve its neighbour, either by extending its roots, and requiring a greater quantity of nouriſhment than the other; or it may abſorb the peculiar food which is neceſſary for the growth of the other plant. In either caſe, the plant is deprived of a proper quantity of nouriſhment.

It is likewiſe propoſed as a difficulty, Why a poiſonous plant and its antidote will grow in the ſame ſoil, and very near each other. This argument is of the ſame nature with the former. It may be owing either to theſe plants imbibing different juices from the earth, or to peculiarities in the ſtructure and action of their veſſels. Theſe, and many other ambiguous facts, have been advanced on both ſides of this queſtion, which we ſhall not ſpend time in enumerating.

The argument drawn from grafted plants, ſeems more direct and deciſive. A ſtalk of a lemon, grafted on a branch of an orange-tree, grew, ripened its fruit, and preſerved the figure and all the other qualities belonging to a lemon. This plainly indicates, that the organization of the lemon had given a different modification to the juices of the orange, through the intervention of which it received its nouriſhment.

It is alſo certain, that the different parts of the ſame plant have frequently various ſmells, taſtes, *&c.* although the nouriſhment derived from the root muſt be the ſame. This is an evidence, that the different ſtructure of parts in the ſame plants is capable of producing very ſenſible changes in the nature and quality of the ſap.

Repeated experiments ſhow, that many plants of very oppoſite qualities, and even trees, have been nouriſhed and brought to maturity by the pureſt water alone.

It is obſerved, on the other hand, that different plants require different ſoils. This is certainly true: But what then? Does not this difference in ſoil rather depend upon the greater or leſſer quantity, than any peculiar quality in the food? Thyme grows beſt in a dry ſoil; but it will grow equally well in earth carried from a marſh to the top of a mountain.

The roots of plants are fitted to abſorb every fluid that comes within their reach. They have been found by experiment to imbibe fluids that actually poiſon them. From this circumſtance it may be fairly concluded, that they have not, like animals, the ſagacity of chuſing the food that is moſt proper for nouriſhing them, and rejecting that which is either noxious or leſs nouriſhing.

Mr Dickſon, author of an excellent treatiſe on agriculture, publiſhed in 1765, has endeavoured to fix the particular ingredients that enter into the compoſition of the food of vegetables. He contends, that neither earth, water, air, oil, nor ſalt, can be called the food of plants; but he thinks that it conſiſts of a combination of all theſe ſubſtances. His arguments in ſupport of this theory are chiefly drawn from the chemical analyſis, which ſhows, that all theſe ſubſtances may be extorted from vegetables by the force of fire; and from a conſideration that a due admixture of theſe ſubſtances (or ſuch things as contain them) is favourable, and even neceſſary, to vegetation.

His laſt argument is good: But whoever attempts to diſcover the properties of plants, or the ingredients of their food, from a chemical analyſis, will probably never do much ſervice to the ſcience of agriculture. Fire and a retort is capable of torturing either animals or vegetables into forms and qualities which never exiſted either in theſe bodies, or in their food.

We ſhall conclude this ſection with obſerving, that the farmer, in nouriſhing his plants, ſhould be directed entirely by experience. If he knows, that putrid animal and vegetable ſubſtances, that lime, ſoot, marle, *&c.* when applied with judgment, aſſiſt the growth of his plants, and augment his crop, it is of little conſequence whether he be acquainted with their chemical analyſis, or the particular mode of their operation. We do not mean that he ſhould continue obſtinately in the old beaten track, as it is called; but rather that he ſhould try whether he can by any means improve upon the old method, and that his practice ſhould be directed according to the ſucceſs of theſe trials.

PART II.

Of the various Operations upon the Soil, in order to prepare it for the Reception and Nourishment of Plants.

Sect. I. Of Manures.

Every ſubſtance which promotes the growth of plants is denominated a *manure*.

As to the operation of manures, ſome maintain, that they give to the earth an additional quantity of the vegetable food; others, that they are of no other uſe than to divide the ſoil, and therefore that tillage may be ſubſtituted in their place. This laſt opinion was embraced by Mr Tull, and is the fundamental principle in his horſe-hoeing huſbandry. A minute diviſion of the ſoil will do a great deal; but the experience of all ages ſhows that it will do much more by the addition of manure.

In Scotland, it is the univerſal practice to dung lands, that are in conſtant tillage, at leaſt once in five years; and it conſiſts with obſervation, that the ground is conſiderably enriched the firſt year, but that the crops gradually decline till the virtues of the dung are entirely exhauſted.

Some manures loſe their virtue by being long expoſed to the air. If dung be kept after it is ſufficiently rotted, the moſt valuable part of it will evaporate. Others, as lime and marles, are of an oppoſite nature: the longer they are expoſed to the air, their utility to the land is improved. From this circumſtance it is probable, that marles and lime attract ſomething from the air which renders them more favourable to vegetation.

There is a great variety of ſubſtances which, when laid upon land, act as manures. But the moſt uſual manures in this country are dung, lime, marles, aſhes, ſoot, ſea-weed, ſhells, *&c.*

Of Dung.

Dung is properly the excrement of animals; but what commonly goes by that name, is a mixture of excrements, putrefied vegetable and animal ſubſtances. If dunghills be kept after they are ſufficiently rotted, the oily and more volatile parts, which are the beſt ingredients, fly off. They ſhould likewiſe be placed in a dry ſituation, and raiſed high at the ſides, to prevent theſe parts from being carried off by water; for much water prevents the uniform putrefaction of dunghills of this mixed kind.

To promote a proper putrefaction, the dung ſhould not be laid in ſmall heaps, but ſpread thick upon the dunghill; for by this means the fermentation commences ſooner, the natural ſap is preſerved, and the dung is prevented from being burnt, or *fire-fanged*, as it is termed by farmers. Dung, when burnt in this manner, is dry, white, and uſeleſs as a manure. It is agreed, that dunghills ought to be covered, to prevent the exhalation of vegetable food. But the difficulty is, how to execute it. Some propoſe a thin layer of earth for this purpoſe; others, that a pit ſhould be dug, built with flags at the ſide, and covered with a roof. The former would anſwer very well, were it not for the additions that are conſtantly making to dunghills; and the latter is ſo expenſive, that few people will chuſe to make trial of it. When dung comes from the ſtable or byre, it is mixed with ſtraw; which abſorbs the moiſture, and prevents it from exhaling till the ſtraw itſelf putrefies. When in this ſituation, if it be laid thick upon the top of the dunghill, there being but a ſmall ſurface expoſed to the air, the juices will be tolerably well preſerved.

As dung thus loſes its beſt qualities by being expoſed to the ſun and weather, it ought to be plowed in as ſoon as poſſible, after being laid upon land. If ſufficiently putrefied, it ſhould be plowed in with a ſhallow furrow, as its juices are waſhed down by the rain: It ſhould likewiſe be ſpread very equally; for when large pieces lie ſcattered up and down, they become a nidus to inſects and vermin.

Of Lime.

Lime being of an alkaline nature, attracts acids: Hence it is ſuppoſed to communicate to the ſoil a power of attracting the vegetable food from the air. Lime is a heavy ſubſtance, and penetrates deep into the ſoil; it ſometimes even ſinks below the reach of the plow. By fermenting with acids, it breaks down and divides the ſoil into ſmall particles, and makes it ſoft, mellow, and evidently in a ſtate of fermentation. It likewiſe diſſolves oils, and all animal and vegetable ſubſtances, and converts them into vegetable food. This quality renders it peculiarly uſeful in deſtroying root-weeds.

Theſe being the general properties of lime, it is ſuppoſed to have a twofold operation upon land. When a large quantity is uſed, eſpecially after being long expoſed to the air, it promotes vegetation by giving a kind of ſtimulus to the ſoil, and making it exert itſelf. This operation of lime is not merely hypothetical; for experience ſhews, that land thoroughly limed may be reduced to a poorer condition by cropping, than if it had not been limed at all. It is even poſſible to reduce limed land to a *caput mortuum;* and the more frequently and the better the land is plowed, it is the ſooner reduced to this ſtate.

Lime alſo enriches land, by augmenting the vegetable aliment. When intended for this purpoſe, only a ſmall quantity ſhould be employed; as a ſmall quantity of lime is ſufficient to impregnate a large quantity of earth, and

and to communicate to it as high a degree of an abforbing quality as it is capable of receiving.

Thefe different operations of lime is confirmed by experience, and agreeable to the practice in thofe parts of Scotland where lime is moft ufed. When employed for the purpofe of improving barren lands, it is laid on in large quantities, to give a ftimulus to the foil, and make it exert all its vigour; and when applied to land already improved, it is ufed in fmall quantities, and repeated once every third or fourth year, to prevent too great an exertion, and impoverifhing the land, by exhaufting too much of the vegetable food.

The lands in Scotland capable of the greateft improvement by lime, are the out-field and muir lands. The out-field land is generally kept three years in tillage, and carries three crops of oats; it is then allowed to reft fix years, and after that is brought again into tillage. This method of cultivating out-field land is found, by calculation, to be fufficiently able to bear the expence, and allow a reafonable profit to the farmer, befides the improvement the lands derive from the lime.

In England, lime is fometimes ufed as a top-dreffing for wheat. The method is this: They fow their wheat without laying on any manure; and in the beginning of February, for every acre of land, they take 20 bufhels of unflaked lime, and 4 bufhels of fand, or brick-rubbifh. Towards the end of the month, the lime is flaked and mixed with the fand: In the laft week of the month, this is fcattered by way of top-dreffing over the green wheat; and as rain generally fucceeds, it is foon wafhed down to the roots of the plant, and gives them a vigour and ftrength of growth that is aftonifhing to people who have never feen this method practifed. But, if the weather inclines to be dry, the quantity of fand muft be doubled, to prevent the plants from being burnt by the corrofive quality of the lime.

Of Marles.

The general characters by which marle is beft diftinguifhed, are thefe: It attracts and ferments with acids, and does not bake in the fire like potter's earth, which diftinguifhes it fufficiently from clay; upon being expofed for fome time to the air and weather, it diffolves like quick-lime, and falls into a fine powder; when dry, it is friable and unctuous like lead-ore; when wet, it is foft and flippery to the touch; whereas virgin-earth is rough and gritty.

There are a great variety of marles; but they are generally reduced to three kinds: The clay, the ftone, and the fhell marle.

The clay and ftone marles are nearly of the fame nature; but the fhell-marle differs from both.

Of Clay and Stone Marles.

Though plants will not grow in thefe marles, when pure; yet, when mixed with foil, they become an excellent manure.

Stone and clay marles are poffeffed of much the fame qualities with lime, and confequently act nearly in the fame manner upon the foil. They communicate to the foil a power of attracting the vegetable food from the air, diffolve the vegetable food, and prepare it for entering the roots of plants. They likewife attract oils fo ftrongly, that they are frequently ufed for extracting greafy fpots out of cloth; they are therefore fuppofed to attract oil from the air and earth, which is the chief ingredient in the nourifhment of plants.

Both the clay and ftone marles are long of diffolving. Large pieces of the ftone-marle are fometimes found undiffolved many years after it has been laid on the land. This renders it neceffary to lay on a large quantity of them, left their effects fhould not at firft appear.

As marle may be ufed with fafety in greater quantity than lime, it muft communicate to the foil a ftronger power of attracting the vegetable food, and confequently it ought always to be preferred. Marle is likewife preferable to lime in this refpect, that it is longer of diffolving; and therefore the land will continue to carry better crops for feveral years longer after it has been marled. However, if the foil be foft and fpungy, the marle, like lime, will fink below the reach of the plough, and prevent thofe advantages which might naturally be expected from it.

Though marle is preferable to lime as a manure; yet it muft be confidered, that their operation upon the earth is the fame; confequently, when marled land has been exhaufted with crops, it cannot receive much benefit from an immediate application of marle a fecond time; for the fame reafon, it can receive as little advantage from lime: Dung therefore, as it contains a great proportion of the vegetable food, which lime and marles diminifh, is the moft proper manure for marled or limed lands exhaufted with crops.

What was faid with regard to the application of lime, in fmaller or larger quantities, to barren lands and lands in good order, may be faid with equal propriety with regard to ftone and clay marles.

Of Shell-marle.

This marle is of a different nature from the ftone and clay marles. It does not diffolve with water, but abforbs and fwells with it like a fpunge: It attracts acids more forcibly. But the principal difference betwixt the fhell-marle and the other marles confifts in this, that the fhell-marle contains a great quantity of oil.

This marle is therefore fuppofed to promote vegetation, by increafing the food of plants, by communicating to the foil a power of attracting this food from the air, by dividing the foil into fmall particles, and by preparing the vegetable food for being abforbed by their roots.

As fhell-marle does not exhauft land like lime and the other marles, it may be repeated as often as the hufbandman pleafes. Its effects are likewife more fudden.

Of Afhes.

The afhes of vegetables contain a large quantity of alkaline falt: Hence they attract acids more ftrongly than any other fubftances.

The

The operation of afhes upon the foil muft therefore be of the fame nature with that of lime, only it is more violent and fudden, and confequently it is fooner over. This is confirmed by experience. After land has been manured with afhes, the firft crop is commonly very luxuriant; but a fecond crop almoft entirely exhaufts the land. Hence afhes fhould be laid on in fmall quantities, and fhould not be applied to land exhaufted by lime or marle; neither fhould they be repeated, or followed by thefe manures.

Burnt turf is generally recommended as a manure. Turfs are chiefly compofed of vegetables; their afhes, therefore, muft be of the fame nature with thofe of wood or any other vegetable fubftance. It is found by experience, that the burning of turfs turns out to advantage in proportion to the number of roots they contain; and therefore land, with a tough fward of grafs, is m ft proper to be improved in this manner.

In burning turf, the heaps muft be covered in fuch a manner as to prevent the flame from breaking out; otherwife the moft ufeful part of the afhes will fly off.

To prevent burnt land from being exhaufted, one or two crops only fhould be taken, and then the land ought to be laid out in grafs. Its fertility will be greatly increafed, if a little dung be added after the firft crop.

Of Soot.

Soot contains oil, falt, and earth. It promotes vegetation in the fame manner as dung or fhell-marle. Soot is generally applied in the Spring as a top-dreffing to winter corn or grafs. The effects of foot ufed in this way are fo fudden, that they evidently appear after the firft rain. But its virtues are commonly exhaufted by a fingle crop. However, when the effects of foot are over, the foil is not exhaufted, as by afhes or lime; it may therefore be repeated as often as the farmer thinks proper; or it may be followed with advantage by afhes, lime, or marle.

Of Sea-weed.

All plants that grow upon rocks, within reach of the fea, are good manures. Thefe are frequently loofened and driven a-fhore by the tide. They are of a foft pulpy nature, and foon putrefy.

Sea-weeds promote vegetation in the fame manner as dung or foot; but their effects are not fo lafting as dung. However, they are preferable to dung in this refpect, that they do not produce fo many weeds.

They may be applied to land in any fituation, and are peculiarly proper for land that is exhaufted by lime or afhes. When their effects ceafe, the land is not injured, and any kind of manure may be ufed after them.

The oftener fea-weeds are applied, the land becomes the richer. This is confirmed by experience. The lands near the fhores, where the weeds have been long ufed as manures, are among the richeft in Scotland, and have been kept almoft conftantly in tillage.

Of Shells.

Beds of fhells are to be met with in many places, but particularly near the fea-fhore.

Thefe fhells ferment with acids, and, like other animal-fubftances, contain oil, falt, and earth. Their operation is fuppofed to be of the fame kind with that of fhell-marle: But, as they take a long time to diffolve, their effects muft be flower and weaker: They ought therefore to be applied in large quantities, otherwife their operation will be hardly perceptible.

Shells exhauft the land, but not near fo much as lime or afhes; it is therefore improper to ufe them immediately after thefe manures.

When fhells are found below the furface of the ground, as they generally are, they fhould be expofed to the air for fome time before they are ploughed in: This not only affifts their fermentation, but promotes their putrefaction.

Of Vegetables in an entire State, or fown for Manure.

It is a practice in many places, particularly in England, to fow turnip, peafe, buck-wheat, *&c.* and to plough them down for manuring the land.

This practice is thought by fome people to be attended with no advantage; becaufe the plants, when ploughed down, can convey no more food to the foil than they take from it. But it ought to be confidered, that fome of the plants employed in this manner pufh their roots below the reach of the plough, and fuck up the food to the furface; the feed that is fown likewife contains a great proportion of vegetable food; befides what the plants, when growing, may derive from the air, *&c.* From thefe circumftances it may be inferred, that they actually return more nourifhment to the foil than they extract from it. The covering of the furface is alfo an advantage: Every farmer knows, that when the foil has been covered for a confiderable time by a ftrong crop of peafe, or any other corn laid down, the foil, though naturally hard and ftiff, becomes foft, mellow, and free.

Of Water.

Rain-water contains a confiderable quantity of vegetable food. When it falls upon land that has a defcent, by running off, it muft carry along with it fome of the fineft particles of the foil and the vegetable food contained in them. If this water, then, is let in upon a field, and allowed to fettle, the land will receive from it not only the vegetable food contained in the water itfelf, but likewife what is contained in the particles of earth carried off from the higher grounds.

This method of manuring can only be ufed in fields which lie on the fides of rivers, or fuch as can be eafily drained. In practifing it, the water muft not be allowed to run off violently, otherwife it does more hurt than good. Land in grafs is moft proper for this kind of manuring.

manuring. The firmneſs of the ſurface prevents any of the ſoil from being carried off when the water is draining, and the graſs intangles the mud, *&c.* and hinders them from going along with the water.

This operation ſhould be performed in the ſpring. In that ſeaſon graſs-lands ſuffer leaſt from being overflowed.

SECT. III. OF SOILS WITH RESPECT TO MANURES.

SOILS are very different in their natures, and compoſed of very different ingredients. Some ſoils contain more, and others leſs, of the food neceſſary for the nouriſhment of plants. It is neceſſary to inquire into theſe differences, in order to diſcover what manures are moſt proper for each kind.

The ſoils moſt common in Scotland are the black loamy, the clay, the ſandy, and the moſſy. Of theſe there are many varieties, according to the different proportions of that particular kind of earth from which they are denominated. Some ſoils are even ſo blended, that it is difficult to determine what kind of earth moſt prevails in them.

Of the black Loamy Soil.

PURE loam ſeems to be nothing elſe but the earth of putrefied vegetables, accumulated by the ſucceſſive decay of natural or artificial crops. In cultivated lands, dung and other manure greatly increaſe the quantity of the loam.

The principal qualities of loam are theſe: When allowed to reſt, it acquires a degree of coheſion, but never becomes ſo hard and tough as clay: When turned up and expoſed to the air, it becomes free and open, and eaſily crumbles down: When dry, it readily admits water, and ſwells and retains it like ſhell-marle; however, it only retains a proper quantity, and allows the reſt to run off. It alſo contains oil, fermentswith acids, and is of an abſorbent nature.

There is no ſoil altogether pure; but that ſoil which has loam in its compoſition poſſeſſes in ſome degree all the qualities of loam; and theſe qualities are unqueſtionably the moſt proper for nouriſhing plants.

Its oils and ſalts afford food to the plants; the abſorbent quality of which it is poſſeſſed, alſo attracts vegetable food from the air; its friableneſs, and fermenting with acids, give an eaſy paſſage to the roots to acquire this food.

Experience, the only ſure guide in ſubjects of this kind, ſhows that a loamy ſoil is moſt fruitful. Some ſoils, when well limed or dunged, may bear as great crops as the loamy ſoil; but then they require a ſupply much ſooner. The loamy ſoil has likewiſe another advantage over every other: It does not ſuffer ſo much from drought or rain, as clay and ſandy ſoils.

All land called *in-field land* has a certain quantity of loam in its compoſition, probably owing to the dung which is laid from time to time upon it. This is the only diſtinction betwixt out-field and in-field land.

The ſoil which contains a great proportion of loam, requires very little manure. It may be kept conſtantly in good heart by proper tillage and good management.

The common loamy ſoil requires manure, and no kind of manure is improper for it; dung, however, is unqueſtionably the beſt. Lime, unleſs managed with care, is in danger of hurting a loamy ſoil by exhauſting it.

Of the Clay-Soil.

THE richeſt kind of clay-ſoil is that which conſiſts of clay and loam. To diſcover the nature of this ſoil, it is neceſſary to know the qualities of clay.

Clay is a very ſolid body, and its parts adhere firmly together: It does not eaſily admit water, but is capable of containing a great quantity, ſwells but little, and does not eaſily part with it. When dry, clay is very hard, and becomes the harder the more ſuddenly it is dried. In the proceſs of drying, it contracts unequally, and breaks out into rents or fiſſures where the coheſion is weakeſt. It ferments with acids, but has no oil in its compoſition.

From a ſlight view of theſe qualities it appears, that a clay-ſoil is not ſo well adapted for the nouriſhment of plants as the loamy: it is more ſubject to receive injuries from drought or rain. In a rainy ſeaſon, as it is averſe to part with the water after it once admits it, the roots of plants will be much weakened or deſtroyed by being long ſoaked in the water. On the other hand, in a very dry ſeaſon, it becomes ſo hard, that the roots cannot penetrate deep enough to ſearch for food.

Theſe obſervations are fully confirmed by experience. For it is well known to the huſbandman, that the produce of clay-ſoils are extremely uncertain, as they are liable to be deſtroyed by dry or wet ſeaſons. Theſe ſoils labour under another diſadvantage; as they repel water, eſpecially when it falls in ſmall quantities, they reap no benefit from dews or ſlight ſhowers.

The clay-ſoil is ſaid to contain vegetable food, but does not allow it to be eaſily diſſolved: and hence lime, marles, or aſhes, are the moſt proper manures for it, as they divide it into ſmall particles. Theſe manures likewiſe communicate to it a greater power of abſorption; and therefore they will enable it both to receive and tranſmit water more readily, and of courſe make it leſs ſubject to be injured by the weather. Clay-ſoils, when mixed with loam, are very rich; but, when mixed with ſand or till, they are very poor. Poor clay-ſoils require ſuch manures as contain the greateſt quantity of vegetable food; therefore dung, ſhell-marle, ſea-weed, *&c.* are the beſt manures for them.

Of the Sandy Soil.

THERE are two kinds of ſand that enter into the compoſition of ſoils; the one conſiſts of ſmall particles of flint, the other of broken ſhells.

The

The ſandy-ſoil which is compoſed of flinty particles, eaſily receives and tranſmits water; and conſequently is not capable of containing a ſufficient quantity for promoting the growth of plants: Its particles do not adhere, and is therefore unable to ſupport plants that have few roots and grow high. Beſides, it is ſuſceptible of greater heat from the ſun than any other ſoil, which is apt to parch the plants. As this ſoil contains no oil, it muſt be very defective in vegetable food; and, as it has no abſorbent quality, it will receive but a ſmall ſupply from the air.

From the qualities of this ſoil, the manures moſt proper for it are eaſily diſcovered. Clay will make it firmer, and enable it to retain the water; but clay contains little vegetable food. Dung will ſupply it with the food of plants; but will not render it firm, or make it retain water. Moſs will help it to retain water, and ſupply it with vegetable food; but will not make it firmer. A mixture of clay and dung, or of clay and moſs, ſeems therefore to be the moſt proper manure for this ſoil.

The qualities of a ſandy ſoil compoſed of broken ſhells, are nearly the ſame with thoſe of the former kind. The only differences are, that it ferments with acids, contains oil, and is capable of being diſſolved. Hence this ſoil muſt have a larger quantity of vegetable food, and muſt alſo receive a greater ſupply from the air. A mixture of dung and clay, or of moſs and clay, is likewiſe the moſt proper manure for this ſoil: But if any ſubſtance could be found that could reduce the particles of the ſhells to a ſtate of putrefaction, it would be preferable to any thing hitherto known for improving a ſoil of this kind.

Of the Moſſy Soil.

Moss principally conſiſts either of live or at leaſt uncorrupted vegetables. It muſt therefore have ſalt and oil in its compoſition. It does not eaſily putrefy, and prevents other bodies from putrefying. It ſwells with water like a ſpunge, and does not eaſily part with it.

To render the moſſy ſoil fit for nouriſhing plants, the vegetables in it muſt be reduced to a ſtate of putrefaction. This will not only ſupply it with vegetable food, but likewiſe render it firmer, and make it more eaſily part with water. Hence thoſe manures which ferment moſt violently with acids, as the clay and ſtone marles, ſeem to be the moſt proper for this ſoil. Theſe marles will not only raiſe a violent fermentation, but fill up the pores, and make the ſoil more ſolid. When the moſs is deep, or has not a ſolid bottom, lime is improper, becauſe it will ſoon penetrate beyond the reach of the plough; but, if it has a ſolid bottom, lime will anſwer very well.

It is improper to ſow upon this ſoil till the fermentation raiſed by the manure is completely finiſhed; for the violence of the fermentation ſometimes throws the ſeeds, and even the roots, out of the ground.

Frequent ploughings make the moſſy ſoil run much into weeds; and from this circumſtance, the practice of ploughing it but ſeldom is found to anſwer better.

Sect. IV. Of the Impediments to Vegetation.

1. Weeds, *as an Impediment to Vegetation.*

Every vegetable that grows in a field, different from the particular plant that is intended to be cultivated, may be called a *weed.*

Weeds injure the plants we deſire to cultivate, by robbing them of part of their nouriſhment, and by preventing the ſpreading of their roots. Some weeds, as quickening graſs, extend and interweave their roots in ſuch a manner that it is difficult to pulveriſe the ſoil by tillage. It is therefore of great importance to the farmer to know how weeds may be deſtroyed. Weeds are generally divided into three claſſes, *viz.* thoſe that are propagated by the ſeed; thoſe that are propagated by the roots; and ſhrubs.

Of deſtroying Weeds that are propagated by Seed.

Weeds are very different in their natures. Some, if prevented from vegetating, die in a few years by lying moiſt in the earth; others will lie many years in this ſituation, without loſing the power of vegetating.

The firſt kind may be deſtroyed, by turning the land infeſted with them into graſs for five or ſix years; and both kinds may be rooted out by allowing them to vegetate, and then tearing up the young plants before they begin to flower.

In order to promote the vegetation of the weeds that are intended to be deſtroyed, the land ought to be well ploughed; if a little dung, or other manure, be applied, the crop of weeds will be increaſed, and their deſtruction will be rendered more general.

Several weeds, as the thiſtle, dandelion, rag-weed, *&c.* are furniſhed with a kind of down, by which they float in the air, and are carried to great diſtances by the wind. Farmers ſhould be as careful to root out all weeds of this kind from the roots of hedges, banks of fences, *&c.* as from their arable land; for although they may have the appearance of being inoffenſive in that ſituation, they are tranſported from thence in great quantities by the wind into the adjacent fields.

There is another great ſource of weeds, but too little attended to by farmers. It is a general practice, to throw the ſeeds that are ſeparated from the corn in winnowing upon the dung-hill; and by this means they are carried out with the dung, and again ſown upon the land.

Of deſtroying Weeds that are propagated by the Root.

There are many different kinds of weeds propagated by the roots. Some of them infeſt land that is in tillage, and others land that is in graſs.

Thoſe that infeſt land in tillage may be deſtroyed by turning it into graſs for ſome years. This is the moſt effectual

effectual means of rooting out quicken-grafs, and other root-weeds of the fame nature. If the foil be hard and ftiff, it is the fooner cleared of weeds by being laid out in grafs; But a foft fpungy foil requires to be in grafs fix or feven years before the weeds are deftroyed.

Thofe weeds that infeft lands in grafs, are eafieft deftroyed by turning the land into tillage. Neither is it neceffary to continue it long in this fituation; for the weeds commonly difappear after the firft ploughing.

But as, in fome cafes, it may be inconvenient to turn a field infefted with weeds from tillage into grafs, or from grafs into tillage, it is neceffary to confider whether the fame may not be accomplifhed, without altering the fituation of the land.

When land is in tillage, the weeds may be deftroyed by frequently ftirring and turning it over in dry weather; for when the weeds are difplaced, the drought prevents them from taking root again.

Land cannot be made too fine, nor the furface too fmooth, when it is intended to be freed of feed-weeds; becaufe by that the greateft number are brought to vegetate: But, when intended to be freed of root-weeds, the rougher the furface, the weeds are the more eafily deftroyed; becaufe the drought has the eafier accefs to their roots.

If grafs-lands be infefted with weeds, and it is inconvenient to turn them into tillage, the only way of deftroying the weeds, is to cut them frequently, or pull them up by the roots.

Some lands, after being in grafs a few years, are liable to be over-run with fog: In this cafe, rolling, by making the furface firmer, will be of great ufe in deftroying the fog. This weed, as well as others, may be deftroyed by depriving it of air. This may be done by covering the furface with a crop of peafe, potatoes, or other plants that lie thick on the furface. A deep trenching will, in fome cafes, anfwer the fame intention.

Of deftroying Shrubs, as Furze, Broom, Bramble, &c.

1. FURZE.

The common method of deftroying furze (or whins) is by grubbing them out with a hoe. But it is impoffible to root them out fo compleatly as to prevent their fpringing again, efpecially if the land be continued in grafs. The moft effectual method, therefore, is to bring the land into tillage immediately after the whins have been grubbed up. As long as it continues in tillage, no whins will appear; but if turned into grafs, they grow as numerous as ever.

To prevent this return of whins, the young plants that appear after the land is turned into grafs, fhould be pulled up by the roots. Unlefs they are very thick, this is neither troublefome nor expenfive: When the ground is moift, it may be performed by young boys. If any of them rife afterwards, which is commonly the cafe, the fame operation muft be repeated every feafon till the land is compleatly cleared of them.

There is another fcheme of management which in a few years will effectually deftroy whins. It is certain that the feeds of whins will not vegetate unlefs they are allowed to lie in the earth undifturbed for a confiderable time. As long as land is left in tillage, although there be many whin-feeds in it, yet they never vegetate. Whin-plants do not even appear till two years after the land has been allowed to reft, or has been turned into grafs. Now, if a fcheme of management be followed, by which the land is turned from tillage into grafs, and from grafs into tillage, the whins by degrees will be wholly eradicated.

It was obferved above, that before lands infefted with whins can be improved, the whins muft be grubbed up. This operation is both tedious and expenfive. The following method of rooting them out by the plough is more expeditious, lefs expenfive, and has been tried with fuccefs.

This work muft be performed by a ftrong Scotch plough, with a well redd beam. As it requires great force to tear up the roots, fix horfes fhould be yoked in pairs. Two drivers are likewife neceffary, to prevent the horfes from ftepping afide. As the whins in rifing are apt to entangle or choke the beam, another man is alfo neceffary to pufh them off with a pitch-fork. A plough yoked and attended in this manner, will plow down whins near three feet high, with roots above four feet long, and an inch in diameter. This operation fhould be performed in the winter, when the land is well foaked with rain.

After the land has been ploughed in this manner, it fhould be allowed to lie till fummer, when the whins torn up by the plough may be burned, the land harrowed, and the roots gathered. Afterwards the land may be dreffed according to the judgment of the farmer; only the fecond ploughing fhould be acrofs, that any roots which have been left may be torn up.

But when the whins are fo ftrong that it is impoffible to plough them down, they may be burned; and if the land be allowed to lie a few years after, it may be ploughed without much difficulty.

2. BROOM.

Broom is not fo bufhy, and does not cover the furface fo much as whins; and therefore land infefted with it is more eafily cleared. Though the methods recommended for deftroying whins will moft effectually deftroy broom, a more fimple and lefs expenfive one will fufficiently anfwer the purpofe.

If broom, efpecially when it is old, be cut fo low as to take away all the leaves, it will never fpring again. A kind of fcythe has lately been invented, by which broom may be cut in this manner with great expedition. If this method be obferved, it is unneceffary to bring land from grafs into tillage in order to clear it of broom.

3. BRAMBLE.

This plant is of a very different nature from whin or broom. The root finks deep into the earth, and fpreads very wide. Though cut in the winter, it rifes and comes to fuch perfection as to carry fruit in the fummer. It

It is therefore a difficult matter to clear land of bramble, efpecially when it is ftony; for the bramble pufhes and interweaves its roots among the ftones, which renders it neceffary to dig out the ftones before it can be fufficiently rooted up by ploughing or tearing. However, digging out the ftones, and ploughing the land in fuch a manner as is moft proper for cutting and tearing up the roots of bramble, may be the more fafely recommended, as they at the fame time ferve many other ufeful purpofes.

2. *Of* WATER, *as an Impediment to Vegetation.*

SOME plants require a greater, and fome a leffer proportion of water in their food. The plants ufually cultivated in our fields are of the latter kind, and are eafily injured by an over-proportion of water. Hence, water may be confidered as an impedement to vegetation; and it becomes neceffary to confider the moft proper methods of conveying it off the land.

Of draining Land.

SOME lands are wet from their fituation, being expofed to overflowings from higher grounds, and having no proper defcent to allow the water to run off.

The bottom of fome land is of fuch a nature as to force out, in fprings, the water that runs below the furface. Springs fometimes break out, becaufe the channels, in which they run, reach the furface; and fometimes becaufe they are interrupted in their courfe, which makes them force their way above ground.

The wetnefs of land is fometimes occafioned by violent and frequent rains; and fometimes all thefe caufes may concur in rendering land wet.

Land that is wet from its fituation may be drained in this manner: Although the wet land be fo low, as to render it difficult to carry off the water; yet the water may be intercepted by a drain, before it reaches the low ground.

Land, wet by fprings, lies generally in a floping direction, which makes it the more eafy to drain. When the water runs near the furface, before it breaks out, it may be intercepted by a drain drawn acrofs the declivity, a little above the place where it firft makes its appearance. But, if the channel lies deep, the drain fhould be drawn directly acrofs where it fprings up.

But, when the wetnefs of the land is owing to the climate, or a rainy feafon, the water cannot be interrupted by drains; however, obftructions may be removed, fo as to allow the water to run off as quickly as poffible. To drain land in this fituation, it is neceffary to lay it up in ridges properly placed, and to cut fmall drains acrofs thefe ridges, communicating with each other, and with the furrows. By this method all the furrows betwixt the ridges become drains; the water, as it falls upon the ridges, immediately makes its way to the furrows; and, if it meets with an interruption in any of them, it is conveyed by the drains acrofs the ridges into fome other furrow, along which it is carried off the field.

There are two kinds of drains, *viz.* open drains, and hollow drains. Hollow drains differ from open ones, in being filled with loofe ftones, covered with turff, brufhwood, or ftraw, and a layer of earth thick enough to allow a plough to go eafily through above. Thefe hollow drains are attended with two advantages; no land is loft by them, and they are no impediment in ploughing.

Open drains, however, are in moft cafes preferable to hollow ones: They alone are capable of intercepting overflowings from higher grounds, and for carrying off water that falls in rain. The water in thefe cafes being always on the furface, will run freely over hollow drains, efpecially when fituated on a declivity. But hollow drains may be ufed with advantage in land wet by fprings; becaufe nothing more is required than to continue the channels of the water below ground, and not allow it to break out, till it arrives at a place where it can do no harm.

It will not be improper here to mention, that fome foils retain water much longer than others, and confequently are more liable to be damaged by water. Soils that have a large proportion of clay, or of mofs, are of this kind. As thefe foils naturally retain water like a fpunge, cafting drains, and laying the land up in ridges, will not convey it away. To drain fuch lands, their nature, and power of retaining water, muft be changed by culture.

The clay-foil can only be drained by frequent ftirring, and the application of fuch manures as raife a fermentation. Thefe operations open the pores of the foil, and thereby afford a free paffage to the water.

The moffy foil, on the other hand, is too open and porous, but is poffeffed of an abforbing quality, by which it retains the water. To drain this foil, it is neceffary to condenfe it, and, if poffible, to deftroy its quality of retaining water. Frequent ftirrings, and fuch manures as raife a fermentation, and tend to putrefy the mofs, are faid to render it firm and folid, and thereby both prevent it from receiving fo large a quantity of water, and deftroy the quality of retaining it.

Of draining Marifhes.

THE foil of marifhes, being compofed of diffolved vegetables, duft blown in by the winds, and earth wafhed down from the high grounds with which they are generally furrounded, is light and fpungy, but very rich and valuable when drained.

In draining a marifh, all the ftagnating water fhould be firft carried off by a large open drain, with a fufficient fall, and as deep as the bottom of the marifh. When the ftagnating water is conveyed away, the earth by degrees will fubfide, and become folid; and fome land will thus be gained on each fide: The bottom likewife foon becomes firm enough to allow the drain to be gradually carried forward through the middle of the marifh. If the fprings, which fupply the water, rife near the middle of the marifh, this principal drain, with a few branches on each fide, where the fprings are largeft or moft

moſt numerous, will be ſufficient. But, if the ſprings be irregularly diſperſed through the whole mariſh, as is frequently the caſe, ſide-drains parallel to the principal one will be neceſſary to intercept the water that comes from the higher grounds and ſupplies the ſprings. Croſs drains, communicating with the parallel and principal drains, are likewiſe neceſſary; and ſhould all be kept open till the ſoil hath fully ſubſided, and become firm; then the ſide-drains and croſs-drains may be converted into hollow-drains, in the manner above deſcribed. But the principal drain, eſpecially if the mariſh be extenſive, ſhould always remain open.

SECT. V. Of TILLAGE.

TILLAGE is the operation of breaking the ſoil into ſmall particles, by ſtirring and turning it over, laying it up in ridges, &c. In this part of agriculture, it is neceſſary to be acquainted with the different ſoils proper for nouriſhing plants; the inſtruments beſt adapted for ſtirring and turning them over; and the conſtruction and manner of uſing theſe inſtruments.

Soils, with reſpect to tillage, may be divided into ſtiff and light, wet and dry, deep and ſhallow. This diviſion is the more proper on this account, that the method of performing the operation of tillage has always a reference to one or more of theſe qualities of ſoil, and to no other.

The inſtruments employed in tillage are various; as the plough, the harrow, the roller, &c. which are again greatly diverſified by differences ariſing from their conſtruction and particular uſes.

1. *Of the Scots Plough.*

IN Scotland, this plough is ſtill the moſt common and the moſt generally underſtood. If properly made, it is the beſt plough for anſwering all purpoſes, when only one is uſed; though others are, perhaps, more proper for ſome particular purpoſes.

The parts of which this plough is compoſed are, the head, the beam, the ſheath, the wreſt, the mold-board, the two handles, the two rungs, the ſock, and the coulter; the two laſt are made of iron, and all the reſt of wood.

The HEAD, Plate VIII. fig. 1. is deſigned for opening the ground below. The length of the head from A to B is about twenty inches, and the breadth from A to D about five inches; C is the point upon which the ſock is driven, and the length from B to C is about ſix inches; *a* is the mortoiſe into which the larger handle is fixed; and *b* is the mortoiſe into which the ſheath is fixed.

The head is that part of the plough which goes in the ground; therefore the ſhorter and narrower it is, the friction will be the leſs, and the plough more eaſily drawn; but the longer the head is, the plough goes more ſteadily, and is not ſo eaſily put out of its direction by any obſtructions that occur. Twenty inches is conſidered as a mean length; and five inches as the moſt convenient breadth.

The SHEATH, fig. 2. E, is driven into the mortoiſe, fig. 1. *b*, and thus fixed to the head A B. It is not perpendicular to the head, but placed obliquely, ſo as to make the angle formed by the lines A E and E B about 60 degrees. The ſheath is about 13 inches long, beſides what is driven into the mortoiſe *b*; about three inches broad, and one inch thick.

The ſheath is fixed to the mold-board, as in fig. 11. E, in the ſame manner as the wreſt is fixed to the head in fig. 7.

The MOLD-BOARD is deſigned to turn over the earth of the furrow made by the plough; and it is obvious, that, according to the poſition of the ſheath, the mold-board will turn over the earth of the furrow more or leſs ſuddenly. Beſides, when it forms a leſs angle with the head than 60 degrees, the plough is in great danger of being *choked*, as the farmers term it.

The Larger HANDLE, fig. 3. F A, is fixed to the head, by driving it into the mortoiſe *a*, fig. 1. It is placed in the ſame plane with the head; and its length from A F is about five feet four inches, and its diameter at the place where it is fixed to the beam is about two inches and a half, and tapers a little to the top F. About ten inches from A, there is a curve in the handle, which, when F is raiſed to its proper height, makes the lower part of it nearly parallel to the ſheath E B. This curve is deſigned to ſtrengthen the handle. The proper poſition of the handle is, when the top F is about three feet two inches higher than the bottom of the head A B.

The longer the handles, the plough is the more eaſily managed, becauſe the levers are more diſtant from the centre of motion. The higher the top of the handles, the plough is more eaſily raiſed out of the ground, provided they be no higher than the lower part of a man's breaſt.

The BEAM, fig. 4. is fixed to the larger handle and the ſheath, all of which are placed in the ſame plane with the head. The length of it, from H to I, is about ſix feet; its diameter is about four inches. When the plough is in the ground, the beam ſhould be juſt high enough not to be incommoded by any thing on the ſurface.

The poſition of the beam depends on the number of cattle in the plough. When two horſes are yoked, the beam ſhould be placed in ſuch a manner as to make the perpendicular diſtance betwixt the bolt-hole of the beam and the plane of the head about 21 inches; when four horſes are yoked, two a-breaſt, this diſtance ſhould only be about 18 inches.

The SOCK, fig. 5. B P, is fixed to the end of the head, and is about two feet long. In fitting the ſock to the head, the point ought to be turned a little to the land or left ſide; becauſe otherwiſe, it is apt to come out of the land altogether. When turned to the left, it likewiſe takes off more land; when turned upwards, the plough goes ſhallow; and when downwards, it goes deeper.

The COULTER, fig. 6. is fixed to the beam, and is about two feet ten inches long, two inches and a half broad, ſharp at the point and before, and thick on the back, like a knife. It is fixed and directed by wedges, ſo as to make the point of it equal to, or rather a little before

before the point of the ſock, and upon a line with the left ſide of the head. This oblique poſition enables it to throw roots, *&c.* out of the land, which requires leſs force than cutting or puſhing them forward.

The Wrest, fig. 7. B D, is fixed to the head, and is about 26 inches long, two broad, and one thick. It is fixed to the head at B, in ſuch a manner as to make the angle contained between the lines A B and B D about 25 degrees. The wreſt is ſeldom or never placed in the ſame plane with the head, but gradually raiſed from the place where it is fixed to it; that is, from B to K, as in fig. 8. The poſition of the wreſt determines the nature of the furrow. When the wreſt is wide and low ſet, the furrow is wide; and when it is narrow and high ſet, the furrow is narrow.

Fig. 9. repreſents the two Handles, fixed together by the two rungs. The larger handle has been already deſcribed; the leſſer one is a few inches ſhorter, and does not require to be quite ſo ſtrong. The diſtance of the handles at the little rung depends on the poſition of the wreſt. Their diſtance at M and P is about two feet ſix inches. The leſſer handle is fixed to the mold-board at M, fig 10. and to the wreſt K B, at L.

Fig. 11. repreſents the plough complete, by joining together figures 6. and 10. in the ſheath E B. The wreſt B K is ſuppoſed to make an angle with the head A B, as in fig. 7. and the handles joined together, as in fig. 9.

After having given ſuch a particular deſcription of all the parts and proportions of the Scots plough, it will eaſily appear how it ſeparates, raiſes, and turns over the earth of the furrow. If it had no coulter, the earth would open above the middle of the ſock, and in a line before the ſheath; but as the coulter opens the earth in a line with the left ſide of the head, if the ſoil has any coheſion, the earth of the furrow will be wholly raiſed from the left ſide, and as the ſock moves forward, will be thrown on the right ſide of the ſheath, and by the caſting out of the mold-board, or the raiſing of the wreſt, will be turned over.

This plough, though the beſt general one, is not altogether perfect. As the ſock is high in the middle, and round on the ſides, and as the point of it is in a line with the middle of the head, a great force is neceſſary to raiſe the earth of the furrow. Beſides, as the ſheath is nearly in a line with the point of the ſock, and to the right of the left ſide of the head, the earth of the furrow, as it is raiſed, muſt ſtrike againſt the ſheath, and a part of it, inſtead of being turned wholly to the right, will fall to the left ſide. Theſe defects make the plough heavy to draw; and, beſides, this poſition of the ſheath renders the Scots plough improper for hoeing, as the earth that falls to the left buries the young plants in the rows.

To remedy the defects ariſing from the ſock, it ſhould be made ſtraight on the land-ſide, ſo as to be in a line with the land or left ſide of the head; and ſtraight alſo below, ſo as to be in a line with the under ſide of the head, ſloping on the furrow or left ſide; and likewiſe on the upper ſide from the point, ſo as to make it, at the root, about ſeven inches broad, and three inches thick; at the ſame time ſloping all the way from the land to the furrow, ſo as to form the furrow-ſide into a ſharp edge. It is obvious, that this ſock will meet with leſs reſiſtance than the common one, will raiſe the earth of the furrow wholly from the left ſide, and turn it as it is raiſed.

To remedy the defect ariſing from the ſheath, it ſhould be brought a little nearer the larger handle, and another ſheath ſhould be fixed a little before it, to the left or land-ſide of the head and beam; to this ſheath the mold-board ſhould be fixed. If this be done, the earth of the furrow, as it is raiſed, will be reſiſted by the mold-board only, and wholly turned to the right.

The Bridle, or Muzzle, is another article belonging to the plough. It is fixed to the end of the beam, and the cattle are yoked by it. The muzzle commonly uſed is a curved piece of iron, fixed to the beam by a bolt through it. In fig. 12. A B C is the muzzle, A C the bolt by which it is fixed to the beam; D is the ſwingle-tree, or croſs-tree, to which the traces are fixed; and B is a hook, or cleek, as it is commonly called, which joins the muzzle and ſwingle-tree.

Some uſe another kind of muzzle, fig. 13. A B C D. It is fixed to the beam by two bolts, and has notches by which the cleek of the ſwingle-tree may be fixed either to the right or the left of the beam. There are alſo different holes for the hind-bolt to paſs through, by which the draught may be fixed either above or below the beam. A D is the fore-bolt upon which the muzzle turns; on B C are four notches, betwixt any two of which the cleek of the ſwingle-tree may be fixed. When the cleek is fixed at B, the plough is turned towards the firm land, and takes off a broader furrow; and when fixed at C, it is turned towards the ploughed land, and takes off a narrower furrow. E and F are the holes on each ſide through which the hindmoſt bolt paſſes. When the bolt is put through the higheſt two, theſe holes being thereby brought to the middle of the beam, the fore-part of the muzzle is raiſed above the beam, and the plough is made to go deeper; and when put through the loweſt two, the fore-part of the muzzle is ſunk below the beam, and the plough is made to go ſhallower. This muzzle may be ſo conſtructed as to have the ſame play with the common one. Fig. 16. A is the end of the beam; B a plate of iron ſunk into it, and, with a ſimilar one in the other ſide, is rivetted into it by bolts; C is the muzzle fixed to theſe plates of iron by the bolt D, which bolt may be put through any of the holes E E. From the conſtruction of this muzzle it is plain, that it has the ſame play with the common one, and that by it the land of the plough may be altered at pleaſure.

Of the Plough with the curved Mold-board.

The mold-board of the Scots plough is not quite ſtraight, but is caſt out above, and more and more ſo as it approaches the leſſer handle.

Ploughs with a curved mold-board commonly have no wreſt, the mold-board ſerving for both. The under-part of it, which ſerves in place of the wreſt, becomes parallel to the plane of the head as it approaches the handle; and ſometimes, after it has paſſed the handle, is

is made to turn inwards; and the fore-part of it, which is ſtraight below, is more and more curved the further up it comes, reſembling the bow of a ſhip.

If one mold-board be preferable to another, it muſt be either becauſe it throws the earth of the furrow more properly, or makes the plough more eaſily drawn. Now, the uſe of the mold-board is to raiſe the earth, turn it over, and, if it be taken off narrow, to ſhift it a little to the right hand. The common mold-board, when right made, performs all theſe operations gradually. But the curved mold-board, as it is caſt out above in the fore-part, prevents the furrow from riſing, and turns it over ſuddenly. In land that eaſily breaks in pieces, the common mold-board has the advantage, becauſe it raiſes the earth of the furrow higher than the other, and leaves it more looſe and open. But the curved mold-board is preferable in land that is not eaſily broke, for, by turning over the earth ſuddenly, it is apter to tear it aſunder.

The plough is more eaſily drawn by the common mold-board, as it has leſs friction than the curved one.

Of the Plough with the feathered Sock.

The difference between the feathered and the common ſock will be beſt underſtood by comparing their figures. Fig. 14. is the common ſock, and fig. 15. the feathered one.

From the conſtruction of the feathered ſock, it is obvious, that it muſt meet with greater reſiſtance than the common ſock. However, when the plough takes off the earth of the furrow broader than that part of the ſock which goes upon the head, it is more eaſily drawn than the plough with the common ſock; for the earth which the common ſock leaves to be opened by the wreſt, is more eaſily opened by the feather of the other ſock. In lea, the feathered ſock makes the plough go more eaſily, becauſe the roots of the graſs, which go beyond the reach of the plough, are more eaſily cut by the feather than they can be torn aſunder by the common ſock. The feathered ſock is alſo of great uſe in cutting and deſtroying root-weeds. The common ſock, however, anſwers much better in ſtrong land.

It is proper here to add, that in fitting the feathered ſock to the head, the point of it ſhould be turned a little from the land, or a little to the right hand.

Of the Wheeled Plough.

The Scots wheeled plough is formed by adding wheels to the old Scots plough, and giving it a curved mold-board, or feathered ſock, according to the inclination of the farmer. The advantage or diſadvantage of the wheels is therefore the only thing to be conſidered in this place.

The following are the principal advantages of wheels to a plough of this kind. Wheels regulate the plough; they make it go to a certain depth, take off the earth of the furrow of a determinate breadth, and make the plough very eaſy to manage. Wheels likewiſe make it eaſy for the ploughman to keep the ridges ſtraight, which it is difficult to do without them.

The diſadvantages attending a wheeled plough are nearly equal to its advantages. It has too much machinery, which is an inconvenience in any inſtrument. It is improper for ploughing ridges acroſs. It is alſo very inconvenient for ploughing narrow ridges; for it muſt be frequently altered in ploughing out a ridge. The wheel that goes in the furrow being higher than the other, when both wheels are going upon the ſurface, the beam muſt be changed from its ordinary poſition, and placed in ſuch a manner as to keep the plough even, and to make it go a little deeper than ordinary. When a furrow is made for the wheel to go in, the beam muſt be altered again to its ordinary poſition; and when the ridge is near finiſhed, ſo that both wheels are going in furrows, the poſition of the beam muſt be changed, to keep the plough even, and to prevent it from going too deep.

Of the Four-coultered Plough.

In England, this plough is ſaid to be uſed with ſucceſs. But after repeated trials by thoſe who attempted to uſe it in Scotland, they have been obliged to give it up.

So many coulters in the ground at once muſt meet with many obſtacles, which will give different directions to the plough, according to the different parts of the coulters to which the reſiſtance is applied. Beſides, it is difficult to place the planes of the coulters exactly parallel to each other; and if this be not done, they will be continually acting upon the plough in different directions. When this plough is employed for breaking up graſs-grounds, which is the chief deſign of it, the oblique poſition of the coulters is apt to raiſe the turf in ſuch a manner as to intangle it betwixt them, and thereby entirely ſtop the plough.

This plough ſhould always be made with wheels for regulating its direction; the planes of the coulters ſhould be exactly parallel to each other: The firſt coulter muſt be ſet almoſt perpendicular, and ſhould not go above two inches deep; the ſecond ſhould ſlope a little, and go ſomewhat deeper than the firſt, and ſo on to the laſt.

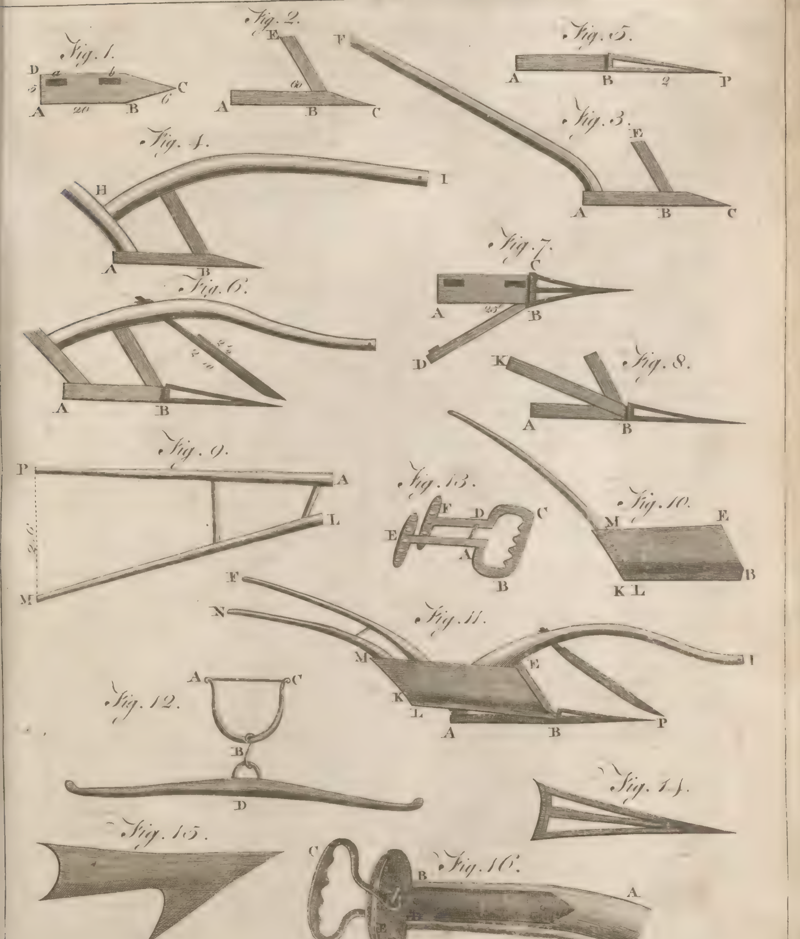
Soft meadow-land, free from ſtones, is beſt adapted to the nature of this plough.

Of the Iron Plough.

This plough is formed upon the model of the old Scots plough; only the ſeveral parts of it are ſhorter, and the head and ſock are of one piece like the Engliſh plough-ſhare.

This plough is lighter, and conſequently more eaſily drawn than any other plough uſed in Scotland; and, as it is ſhorter, the friction is alſo diminiſhed. Neither is the earth ſo apt to ſtick to it, and clog it while going. But theſe are only ſeeming advantages; for the lightneſs and ſhortneſs of it render it extremely ſubject to change its direction upon meeting with the leaſt obſtruction. Soft land,

Plate VIII.



A. Bell Sculp.t

land, with few ftones, therefore, is the only land in which it can be employed with advantage.

The iron plough is fubject to another inconveniency. When any thing goes wrong, it cannot be rectified on the field, but muft be carried to the fmithy, which is often at a confiderable diftance.

Of yoking Cattle in Ploughs.

It is not eafy to determine whether horfes or oxen, or both together, are moft proper for drawing ploughs; becaufe, in this country, fuch a determination depends on circumftances almoft as various as the number and fituation of farms in it. If, indeed, real labour alone was fufficient to determine this point, oxen would be preferred; becaufe they will ftand to the draught, and overcome a refiftance which horfes would yield to. We fhall therefore confine this head to the manner of yoking cattle, without regard to the kind of cattle employed.

The chief queftion on this fubject is, Whether cattle fhould be yoked in pairs, or in a line before one another?

The moft common way of yoking cattle is in pairs. Though this, upon the whole, be the beft method, yet it is fubject to fome difadvantages. In ploughing the furrows betwixt the ridges, the cattle go upon the ploughed land, and tread it down with their feet, which is peculiarly hurtful to wet land: When there is but as much of the ridge unploughed as the cattle have hardly room to go upon, they frequently give the plough a wrong direction by going into the oppofite furrow; or, which is ftill worfe, they are apt to juftle the furrow-cattle upon the ploughed land.

To remove thefe inconveniencies, yoking the cattle in a line has been recommended. But this method has been attended with greater inconveniencies than thofe it is intended to remedy. When yoked in this manner, they go all in the furrow, which makes it neceffary to give the plough more land than ordinary, either by means of the fock or muzzle; and confequently makes the draught too heavy. Befides, when cattle are yoked in a line, it gives fome of them an opportunity of throwing the chief burden upon the others. There is ftill another inconveniency attends this method. When the cattle are all in a line, the whole force is applied to the direction of the traces of the hindmoft horfe; and confequently it cannot have fuch an effect on the plough as when a part of it is in a more horizontal direction.

Each of thefe methods, however, may be ufed with advantage in certain circumftances; yoking in pairs, as it is certainly the ftrongeft draught, fhould be preferred in ploughing ftiff land. On the other hand, yoking in a line anfwers beft in wet land, which is liable to be much hurt by the treading of the cattle.

Of Ploughing.

Ploughing is the action of the plough in ftirring and turning over the foil. By opening the foil and enlarging the furface, it gives it an opportunity of extracting the vegetable food from the air; and confequently increafes the food of plants. Ploughing likewife diffolves and reduces to a ftate of putrefaction the dung, oils, and vegetable fubftances that happen to be mixed with the foil, and prepares them for entering the roots of plants. When properly managed, ploughing deftroys weeds, and drains the land when too wet. Hence, ploughing is one of the moft important operations in agriculture, and therefore merits the greateft attention.

When ploughing is defigned to enrich the land, or increafe the food of plants, the furface cannot be made too uneven; becaufe the more of it is by this means expofed to the influence of the air.

But when the intention of ploughing is to deftroy feed-weeds, the furface cannot be made too fmooth, nor the mold too much broken; becaufe, by this management, their vegetation is promoted, and confequently they may be more completely deftroyed by ploughing them in.

Again, if you plough with a view to remove wetnefs, the land muft be laid up in high ridges; for the greater the number of furrows, and the higher the ridges, the water is more expeditioufly carried off.

Thus the manner of ploughing muft always depend on the object in view. It frequently happens indeed, that two or more of thefe objects require our attention in ploughing the fame piece of land. But the methods above mentioned are perfectly confiftent with each, and may be combined fo as to anfwer any intention that may occur.

In ploughing, there are fome general rules to be obferved, whatever be the object in view. Thus, land fhould never be ploughed when it is wet, becaufe the intention of it will be fruftrated, whatever may be the nature of the foil. A ftiff foil, when ploughed wet, dries fuddenly, and becomes hard. If a light foil be ploughed wet, the water hinders it from being reduced to fmall enough particles. Befides thefe difadvantages, the labour becomes very fevere on the cattle, and the land is much hurt by their treading.

With regard to ploughing lee, or opening up grafs-grounds, the common practice in Scotland is to plough it as fhallow and narrow as poffible, and to fet the turf upon its edge. After this fingle furrow, the land is fown, and if it be good, a profitable crop may be expected; and the turf will be completely rotten before next feafon.

On the contrary, in breaking up of barren land, it fhould be ploughed deep, and the turf turned on its back.

Of Ridges.

It was formerly obferved, that ploughing in ridges removes wetnefs, enlarges the furface, and confequently affords more fpace for the plants to extract nourifhment from the foil.

When the foil is wet, the ridges ought to be narrow, and fteep; becaufe, by this means, the number of drains is increafed, and the water finds its way more eafily into the furrows. They fhould likewife be raifed high in the middle

middle or crown; for the higher they are raiſed, the more is the ſurface enlarged. However, if the ſoil be ſhallow, the ridges ſhould not be raiſed high, as they deprive the furrows of ſoil.

But, in low flat-lying ground, the ridges ſhould be made flat, in order to raiſe the furrows; for, in ſome caſes, the higher the furrows are raiſed, it is the more eaſy to find a fall for carrying off the water. Flat ridges are alſo capable of being ſown with greater exactneſs.

It is impracticable to give any general rule for laying out ridges. In ſome ſituations, narrow ridges are preferable to broad ones; in others, flat ridges are better than ſteep ones, *&c.* In laying out of ridges, therefore, every perſon muſt be determined in this point by the nature and ſituation of the ſoil, and the advantages or diſadvantages of the different kinds of ridges.

But, whatever be the nature or ſituation of the ſoil, the ridges ſhould always be made ſtraight. In ploughing crooked ridges, the cattle muſt often go in a different direction from the plough, and are obliged to take ſhort turnings, which hurt the land by the treading of the cattle. Beſides, when the ridges are crooked, the fall for the water is diminiſhed. In all ſoils too, the ridges ſhould be made of the ſame breadth throughout, and equal to one another. When they are unequal, it is difficult to ſow them with exactneſs, or to alter them when neceſſary; and the plough muſt often turn in the middle of the ridge, which hurts the land by the trampling of the cattle.

Of the Poſition of the Ridges.

It is a matter of ſome conſequence to know how ridges ſhould be placed, ſo as beſt to anſwer the ſituation of the land.

In lands that have a ſlope, the ridges are commonly placed in a ſtraight line from the top to the bottom of the declivity. When the declivity is gentle, this poſition is very proper, as it drains the land of water. But when the declivity is great, this poſition allows the ſoil to be waſhed away by the rain; and the quantity of ſoil carried off will always be in proportion to the violence with which the current runs: Hence, in a ſoil ſituated in this manner, the ridges ſhould be placed acroſs the declivity, to prevent the ſoil from being carried down by the water. Making the ridges very narrow will, in a good meaſure, anſwer the ſame purpoſe; however, it is not ſo proper as placing them acroſs the declivity.

When land is very dry, croſs ridges are alſo of great uſe; for they retain the water, and prevent the ſoil from being waſhed away.

Of ploughing in Ridges.

There are three different ways of ploughing in ridges, *viz.* gathering, caſting, and cleaving.

By *gathering*, the crown and furrows of the ridge are kept in the ſame poſition in which they were before: the plough begins in the crown, and plows out the ridge, turning the earth towards the crown, where it firſt entered. Every ridge is ploughed by itſelf; or the halves of two contiguous ridges may be ploughed together. By this method, as the earth on each ſide is turned upon the crown, and thrown up out of the furrows, the ridge muſt be raiſed higher.

By *caſting*, the crowns and furrows are likewiſe kept in their former poſition: The ridges are ploughed in pairs: The plough may enter in the furrow betwixt the ridges, and plough out the ridges, turning the earth towards the furrow where it entered; or, the plough may enter in the furrow on the right ſide of the two ridges, then turn to the one on the left, and plough out the ridges, turning the earth to theſe furrows, and from the furrow that is betwixt them. By this method of ploughing, the ridges are kept of the ſame height in the crown, and one of the furrows made a little higher, and the other a little lower than before.

Cleaving is the reverſe of gathering. The plough enters in the furrow on the right-ſide of the ridge, turns to the furrow on the left-ſide, and ploughs out the ridge, turning the earth from the crown towards the furrows. Every ridge is ploughed by itſelf, or the halves of two contiguous ridges may be ploughed together. If the ridge be raiſed in the crown, this method of ploughing makes it flatter, by throwing ſome of it into the furrows.

There is another method of ploughing uſed in ſome places, called *ribbing*. This method is performed by making furrows about two feet diſtant from each other. One half of the ſurface is untouched by the plough; and the other half, which the plough turns up in making the furrows, is thrown on the top of what remains faſt. The land may be ploughed in this manner either without regard to ridges, or the plough may be made to enter and turn, as in gathering, caſting, or cleaving. This kind of ploughing is ſeldom practiſed, but in the beginning of winter, and upon land to be ſown with barley, after two additional clean ploughings. Although ſome modern improvers have condemned ribbing, it certainly has its uſes: It keeps the land dry; the rain that falls is confined to the furrows, from whence it is eaſily carried off; it promotes the rotting of the ſtubble, and expoſes a greater part of the ſoil to the influence of the air.

Of Harrows.

The harrow is an inſtrument employed for ſmoothing the ſurface after the land is ploughed. One horſe is ſufficient to draw the harrow commonly uſed in Scotland. Sometimes two of them go a-breaſt, and ſometimes three. When the ſurface is very rough, two are reckoned ſufficient for the attention of one perſon: But when three can be uſed, they make better work, and are nearly equal to two pair.

There are ſeveral kinds of harrows uſed in Scotland. The common one is ſo well known that it needs no deſcription.

When the land is rough, the harrows are apt to ſtart, and get a-top of each other. To prevent this, ſome fix pieces of crooked timber to the out-ſide bulls that are contiguous to one another, which, by ſtretching a little over,

over, keep the harrows in their proper place. Others couple the harrows in ſuch a manner as to allow them to go before and fall back of each other, and at the ſame time turn upon a hinge.

When ſtiff land is ploughed wet, it riſes in large pieces, which, when dry, become ſo hard, that the common harrows make no impreſſion on them. To reduce this kind of land, a large harrow, called a *break*, has been contrived. The break-harrow is ſometimes made of the ſame figure with the common harrow, and ſometimes in a triangular form. Both kinds are made heavier or lighter according to the nature of the ſoil for which they are intended. Some of them are ſo heavy as to require ſix or eight cattle to draw them. But the heavieſt kind are very improper for land infeſted with large faſt ſtones; becauſe their weight hinders them from ſtarting over the ſtones; and therefore they are often in danger of being torn aſunder by the cattle.

There is another harrow, which, though little uſed, will be found to be very uſeful in many caſes. It is of the ſame form with the common harrow, but much broader. The bulls are at a greater diſtance, and conſequently the teeth thinner placed; the teeth are longer than thoſe of the common harrow, but very little thicker; and thoſe in the fore-part ſlope forward. It is made of ſuch a weight as to be eaſily drawn by a couple of horſes. This harrow goes deeper, opens land better, covers the ſeed deeper, and is more proper for tearing up roots than the common harrow.

The French harrow is of a triangular form, with a joint near the angle, to which the draught is fixed. It has two handles, by which it is either made to go deep or ſhallow, as occaſion requires. Its principal uſe is to level ſteep ridges, which it does moſt effectually. It is drawn acroſs the ridges: When, at the crown of the ridge, by preſſing on the handles, the harrow ſinks down, and carries earth along with it to the furrows; and, when at the furrows, by lifting up the handles, the harrow is brought out of the ground, and leaves the earth behind. This operation, however, is extremely improper, unleſs the land be in a very dry ſituation, and not liable to be damaged by water.

Of Harrowing.

Harrowing ſmooths the ſurface, deſtroys weeds, and covers the ſeed after it is ſown.

When the intention of harrowing is to deſtroy root-weeds, the harrows ſhould be drawn acroſs the ridges. However, if ſuch weeds are not fully torn up, the harrowing, by filling up the hollows, and defending the roots from the drought, rather promotes their growth. For this reaſon, harrowing is improper for deſtroying root-weeds, excepting after a ſpring-fallow, when the land is ſoon after to be ploughed for ſeed.

But the ſmoother the ſurface is made, and the more the mold is broke, the vegetation of the ſeed-weeds is the more effectually promoted, and of courſe they are the more liable to be deſtroyed by harrowing. If the ſeaſon be favourable, the land may be harrowed ſeveral times, and as many crops of weeds deſtroyed.

A light ſpungy ſoil can hardly get too much harrowing; for the more it is harrowed, it becomes the firmer. But if the ſoil be ſtiff, the leſs harrowing it gets, the better, provided the purpoſes propoſed can be anſwered.

The common method of harrowing after the ſeed is ſown, is firſt along the ridges, then acroſs, and then along again. When the ridges are flat, they may be harrowed either along or acroſs; and the work may be begun or ended either way. But when the ridges are ſteep, it is improper to begin by harrowing acroſs, becauſe too much of the ſeed will be drawn into the furrows.

Of the Roller.

The roller is intended for ſmoothing the ſurface, and making the land firmer. Rollers are ſometimes made of ſtone, ſometimes of wood, and ſometimes of iron: but the only eſſential difference of rollers lies in their weight. As rollers, in different circumſtances, require to be lighter and heavier, they are generally conſtructed ſo that their weight can either be augmented or diminiſhed.

The common roller, in turning, is very ſevere upon the cattle, for it does not move on its axis, but is dragged along the ſurface. To remove this inconvenience, a roller has lately been conſtructed with a diviſion in the middle, as if two rollers were joined together. In turning, both parts of this roller move round their axis, the one forward, and the other back.

Of Rolling.

Rolling is practiſed with advantage, both on land lying in graſs, and in tillage. It preſſes down mole-hills, ſmooths the ſurface, and makes paſture-graſs ſtool, and grow thicker.

Rolling upon land in tillage, not only ſmooths the ſurface, but breaks clods that the harrow cannot reduce. In a light ſoil, the roller ſhould be applied immediately after the ſeed is ſown; it is peculiarly uſeful to this kind of ſoil, by condenſing and making it firmer.

Of Sowing.

It is remarked by farmers, that the corn which is earlieſt ſown is in general ſooneſt ripe. However, as this operation depends on the nature of the weather, and a number of other circumſtances, no preciſe time can be fixed for performing it.

The practice of ſowing wheat, oats, barley, *&c.* at different times of the year, ſeems not to depend ſo much on the different natures of theſe grains, as on the inconveniencies which would attend the ſowing them all at the ſame time. It may however be obſerved, that wheat, the only grain in this country which is ſown before winter, ſhould be ſown as early as poſſible, that its roots and leaves may be put forth before the froſt comes on.

The moſt common method of ſowing is by the hand. This method requires great ſkill and addreſs in the ſower: For, at the ſame time that he gives his arm a circular motion, to caſt the ſeed with ſtrength, he muſt open his hand

hand gradually, that it may not fall in a heap, but be properly ſcattered and ſpread. It is remarkable, that good ſowers, by the force of habit, take their handful out of the ſheet ſo very exactly, that they will ſow any quantity of ſeed on an acre, according as it is deſigned to be thinner or thicker. But this dexterity in a few ſowers, is itſelf an objection to the method of ſowing by the hand; becauſe long practice and obſervation are neceſſary to make a good ſower: This remark is too well juſtified by experience; for good ſowers are extremely rare, and, in ſome places of the country, hardly to be got. Beſides, in ſowing by the hand, eſpecially when the land is uneven, the ſeed rebounds on the clods, falls into the cavities, and often the greateſt part of it is collected in the furrows.

Different plants require to be ſown at different depths. The ſame ſeeds, however, may be laid deeper in light than in ſtrong ſoils. Wheat requires to be placed two inches and a half or three inches below the ſurface: And it may be laid down as a general maxim in ſowing, that ſmall ſeeds ſhould always be placed nearer the ſurface than ſuch as are larger. Beſides the unequal diſtribution of the ſeed when ſown by the hand, too large a quantity of it may be uſed; for, as it is placed at different depths, that which is too deep never comes up, and that which lies on the ſurface, which may be obſerved on the beſt harrowed land, is eat up by the birds. When ſeed is ſown thin, and placed at equal diſtances by a drill, a leſſer quantity of it, by leaving room to ſpread and branch out, will produce even a better crop than a larger quantity ſown irregularly by the hand. The fact has been confirmed by repeated experiments both in our own country and in France.

SECT. VI. OF THE CULTURE OF PARTICULAR PLANTS.

Of the Culture of Wheat.

THOUGH wheat be the moſt valuable grain that is cultivated in Scotland, there are many places where it cannot be ſown with advantage; for it requires not only a rich ſoil, but a warm climate.

The Engliſh writers mention about 13 or 14 different kinds of wheat; but in Scotland we ſeldom uſe more than two, *viz.* the white and the red wheat. The laſt is reckoned the moſt hardy plant, and ſucceeds in ſome ſoils and climates where the white kind fails. Bearded wheat is uſed in ſome places. This is likewiſe a hardy plant, and is not ſo apt to lodge, or to be ſhaken out by the wind, as the other kinds. It ſucceeds very well in wet land, and the grain produces a great quantity of flour.

The white wheat moſt commonly uſed in Scotland, is not a particular ſpecies, but a mixture of all the ſpecies cultivated in England. This mixture is probably occaſioned by want of care in providing ourſelves with foreign ſeed. It is found by experience, that, in this country at leaſt, wheat degenerates; for which reaſon a freſh ſupply is every year brought from the Engliſh granaries, which generally conſiſts of a mixture of all the kinds. Now it is at leaſt very probable, that theſe different kinds of wheat require different ſoils; and therefore the farmer ſhould endeavour to provide himſelf annually with a quantity of unmixed wheat, of ſuch kinds as are found to ſucceed beſt in Scotland.

Wheat is commonly ſown either upon land that has been ſummer-fallowed, or after a crop of peaſe. In the latter caſe, the ſeed cannot be ſown till October; but in the former, it is generally ſown in Auguſt. However, in Scotland, we ſow wheat from the beginning of Auguſt till the middle of November. Some have tried ſowing wheat in the ſpring; but the plants were neither ſo vigorous, nor the grain ſo large, as thoſe that were ſown in autumn. The ſowing of oats in autumn has likewiſe been tried; but, though the crop was bulky, the quantity of grain was not in proportion. Upon the whole, the month of October ſeems to be the moſt proper time for ſowing wheat; when it is either earlier or later, it is ſubject to a number of dangers.

The quantity uſually ſown upon a Scots acre, is from three to five firlots, Linlithgow meaſure, which is the meaſure always meant in this treatiſe. The proper quantity, however, muſt always depend upon the ſituation of the land: in proportion as it is clean and rich, a ſmaller quantity of ſeed is requiſite; and in proportion as it is poor and full of weeds, a larger quantity becomes neceſſary.

A wet bed is moſt proper for wheat-ſeed. In the month of Auguſt, or even the beginning of September, it is dangerous to ſow, if there be not as much moiſture in the land as to make the ſeed vegetate, eſpecially if the ſeed has been ſteeped in brine, and dried with lime. But though the danger be great in ſowing when the land is very dry, yet the beſt ſituation of land for receiving ſeed is when it contains no more moiſture than is ſufficient to make the ſeed vegetate.

When wheat-land is light, or well reduced by fallowing, the ſeed ſhould be ploughed in, or the land allowed to lie ſome time after it is ploughed before the wheat be ſown. By this the land acquires a degree of firmneſs before the harrows go upon it, and the feet of the cattle are prevented from preſſing the ſeed too deep into it.

Wheat-land ſhould be ploughed ſo as to raiſe the ridges higher in the crown than is neceſſary on other occaſions, in order to prevent it from being damaged by water: If the ridges are made narrower than ordinary, the ſame end will be ſerved, becauſe the water finds its way more eaſily to the furrows. Hence the old practice in Scotland, of cleaving for peaſe, and gathering for wheat, was well founded.

When the wheat is ſown, and the land harrowed, the field ſhould be carefully water-furrowed; and if there be ridges at the ends for the ploughs to turn upon in ploughing, a water-furrow ſhould likewiſe be drawn betwixt them and the ridges, and the communication betwixt theſe and the furrows opened up.

Of

Of the Culture of Rye.

Rye is a winter-grain, and thrives very well on land that is improper for wheat. As there is hardly a good market for this grain in Scotland, it is but little cultivated. In some places, the land is prepared for it by a fallow, and good crops are reaped in this way. It may be sown in October, November, or early in the spring. It may be sown after pease or barley; but it is improper to sow it after wheat or oats, as this would encourage the growth of root-weeds, and greatly exhaust the land.

Rye is sometimes sown as a grass-seed. If it be sown with this view in September, upon a well-prepared fallow, it will afford good feeding for sheep in March and April; and after it is cut down, the land may be ploughed, and sown with barley. This practice, however, will not answer in wet land.

Of the Culture of Barley.

There are four kinds of barley used in Scotland, the common barley, the Lincolnshire barley, the Highland barley, more commonly called *rough bear*, and the Thanet.

These different kinds are sown at different seasons. The Lincolnshire barley may be sown any time during the winter, or in the spring; the common barley and Thanet may be sown in April, the beginning of May, or even later; and the rough bear may be sown in May, or the beginning of June: but the precise time of sowing must be determined by the weather and the situation of the land. When the season is favourable, the land free from weeds, and not too wet, Lincolnshire barley may be sown in February, and the other kinds sooner than the periods above mentioned.

When barley is sown in winter, or early in the spring, the land ought to be ploughed some time before; but when sown late in the spring, or in the beginning of summer, it ought to be sown immediately after it is ploughed. In winter, or early in the spring, land is in no danger of becoming too dry; but in summer, land is very liable to become too dry for the purposes of vegetation. The farmer should therefore endeavour to have all his seed sown before the season be too far advanced.

The quantity of barley sown on an acre is from two to four firlots. When the land is clean and rich, two firlots are sufficient; but when it is infested with weeds, a larger quantity is necessary.

Barley has tender roots, and is not able to push them far in quest of food; it is therefore necessary to bring land destined for barley into good tilth, and to enrich it either by manures or frequent ploughings. Barley is often sown upon land that has been fallowed, or after a crop of pease. In some places it is sown after a crop of oats; and sometimes it is repeated for two or three years successively upon the same land.

When barley is to be sown upon fallow, in stiff land not much infested with annual weeds, it should be dressed in November in the same manner as for wheat; so that Lincolnshire barley may be sown, if the winter be favourable, or spring barley upon the winter-furrow, if the season proves unfavourable. But when barley is to be sown after wheat, pease, or oats, the land should be ploughed as soon after harvest as possible, and laid up in such a manner as to be best exposed to the air and frost, and to secure it against damage from rain. To answer these purposes, barley-land is sometimes ribbed at this season: But ribbing stirs only a small quantity of the soil; and therefore it is better to gather it into narrow ridges of four or six furrows each, and to make proper drains for carrying off the water. As the first ploughing for barley-land is designed to cover the stubble, increase the vegetable food, and keep the land dry, it need not be very deep, but ought to be as broad as possible, provided it be clean ploughed.

If it be proposed to dung barley-land, the dung may be laid on during the winter-frost, and ploughed in as soon as the land is in proper condition. When the dunging is delayed till immediately before the last ploughing, or seed-furrow, the land, especially if it be of a stiff nature, is in danger of being battered so as to rise in large clods when ploughed.

In steering, the ploughing should be as deep as the plough can go, and the soil allows: For by deep ploughing at this season, part of the earth that has been exposed to the air through the winter, and part of it turned up by the ordinary ploughing, are mixed together for the nourishment of the crop. In steering, the furrows should not be so broad as in the former ploughing; on the contrary, the narrower they are the better. Cross-ploughing is very proper at this season, if the land be so dry as to allow it.

After steering, the land should be well harrowed. It makes the weeds spring, retains the sap, and, if the land be tolerably dry, takes out the roots of the quickening-grass. But, if the land be in no danger of losing the sap, the harrowing may be delayed for some time after it is ploughed; for by this method a greater number of weeds are destroyed.

Though, in general, frequent ploughings are beneficial, yet ploughing when the land is wet is destructive. When the spring is wet, the barley-land in many places is not in a proper condition to be sown. In this case, the steering-furrow must be omitted, and the land should get the seed-furrow as soon as it is in a proper condition.

When barley is to be sown a second time upon the same land, without any other crop intervening, two ploughings are sufficient.

As our summers in Scotland are sometimes very wet, barley-land should be water-furrowed, and dressed up in the same manner as wheat-land.

Of the Culture of Oats.

The oat is a very hardy plant, and its roots are strong, which enables it to procure food where many other plants would starve; and hence the practice of giving less culture to oats than to any other grain.

There are three kinds of oats used in Scotland, the white, the black, and the grey. The white is the most common,

common, and ufed in all the low countries; the black is the hardieft, and is ufed in the cold hilly countries; and the grey is often fown with fuccefs upon light gravel or fand. The white is again divided into two kinds, called *cold feed* and *hot feed.* There is fcarcely any difference in appearance betwixt thefe; but the hot feed ripens eight or ten days before the cold. Experience muft determine which of them ought to be chofen for feed.

Though the oat be a hardy plant, and does not eafily degenerate, yet the changing of feed is univerfally allowed to be a good practice. This change fhould always be made from a warm foil to a cold, and from a cold to a warm.

Oats are often fown upon grafs-ground newly broken up, or, which is the fame thing, upon lee once ploughed. They are likewife often fown after barley, fometimes after wheat, fometimes upon fallow, and fometimes they are repeated for feveral years fucceffively upon the fame land.

In ploughing lea for oats, when the land is foft and mellow, the plough fhould go as fhallow as poffible; and the earth of the furrows fhould be fet upon its edges, to allow the harrows to have the greater impreffion in tearing it. But when the land is ftiff, or the turf very tough, it is neceffary to plough deeper, and to turn the turf fully over, fo that the harrows may raife a kind of mold upon its back to fill up the hollows, and to nourifh the feeds. When oats are to be fown upon lee, the land ought to be ploughed early in winter, that it may receive the greater benefit from the air and froft.

It is ufual to lime lea-ground intended for oats. This is a very good cuftom; for lime promotes the corruption of the grafs-roots, by which the land is fooner reduced. It is likewife common to fpread the lime upon the fward fome time before the land is ploughed: This is alfo very proper; for the lime is intangled in the fward, and is not fo apt to penetrate too deep.

Oats are generally fown after barley; and the land is ploughed as foon as the wheat-feed is made, and the barley-land has got the firft furrow. The ftiff land, and land in danger of being damaged by wetnefs, fhould be firft ploughed, to give the one the benefit of the winter-froft, and to put the other out of danger. It is likewife an advantage to light and dry land to be ploughed early in the feafon, as it makes the ftubble rot fooner, and expofes the foil longer to the air.

It was formerly obferved, that oats are fometimes fown upon fallow. In the hilly countries, they often fallow the land that has been in lea for fome years; and they find that this practice does better than giving it only one ploughing in the winter before the feed is fown. In the low countries, this practice of fallowing for oats is found to fucceed very well. The fallow for oats fhould be managed through the fummer in the fame manner as if for barley or wheat. Before winter, it ought to get the laft furrow, and be laid up in proper ridges, to preferve it dry during the winter.

Oats may be fown in any of the winter-months, or in the month of March. Some people have fown oats fo early as the beginning of November, and have had good crops. But, if the land be properly laid up in winter, it is better to delay the fowing till March.

The quantity of oats generally fown upon an acre, is from four to five firlots; and fhould always get a dry bed.

Of the Culture of Peafe.

The pea is a grain very different from any of thofe already mentioned. A crop of it is not fo valuable, though it is much ufed in fome places for bread.

The ftraw of peafe is reckoned better for feeding horfes than the ftraw of any other grain. A crop of peafe does not require fuch a quantity of nourifhment as a crop of any of the other grains mentioned above. When the crop is good, the ftraw covers the ground, and deftroys all the fmall weeds by depriving them of a free communication with the air. Peafe likewife minutely divide the particles of the foil; befides, they pufh their roots much deeper than any of the white grains, and extract part of their nourifhment from below the reach of the plough.

There are two kinds of peafe cultivated in Scotland, the white and the grey. The white is moft common, and confifts generally of a mixture of feveral kinds. All of thefe kinds feem to be fpecies of the pea cultivated in our gardens. The grey pea feems to be a fpecies of the vetch or tare. This is the hardieft plant of the two, and thrives on foils where the white pea does not fucceed.

The ftraw of the grey peafe, and the peafe themfelves, are better for horfes than thofe of the white. The farmer fhould therefore cultivate this pea where the other does not thrive, although the value of the grain be inferior.

The white pea, like the oats, is divided into hot feed and cold feed. The fowing of the hot feed may be delayed three weeks after the cold feed is fown, and yet the peafe will come as foon to maturity.

The time of fowing is from the firft of February to the end of April. The early fown peafe have the beft chance to produce a crop of corn, and the late fown to produce a crop of ftraw. However, when the land is clean and in good heart, the peafe may be fown early; becaufe, on fuch land, a good crop both of corn and ftraw may be expected. But if the land be foul or wet, the fowing of peafe fhould be delayed as long as poffible; becaufe on fuch land the crop is more precarious, and the failing of a crop of peafe gives fuch encouragement to weeds, as to endanger the following crops likewife. In fuch a cafe, to prevent the bad confequences that may follow, the crop fhould be ploughed in; for when a bad crop of peafe is allowed to ftand, it does more harm to the land than all the value of the crop.

The quantity of peafe fown upon an acre, is from 4 to $5\frac{1}{2}$ firlots. If the intention of fowing peafe be to obtain ftraw, and enrich the land, they fhould be thick fown; becaufe in that cafe they have a better chance to deftroy the weeds, and to cover the furface. But when the principal defign is to have a crop of corn, they fhould be thinner fown; for, when thin fown, they have more air, and fill better.

Peafe are commonly fown after oats or barley, and fometimes

ſometimes after wheat. Seldom more than one ploughing is given to peaſe, and they are uſually ſown immediately after it. The reaſon of this practice is, that the ſeed may be better covered; for the ſooner that any grain is ſown after ploughing, it is always the deeper covered. If rain falls ſoon after peaſe are ſown, it makes them ſwell and come above ground, and then they are in danger of ſplitting, and of being deſtroyed by vermin.

Sometimes peaſe are ſown and ploughed in. This anſwers very well in light land, particularly after a crop of barley, the culture of which opens the ſoil.

Land deſigned for peaſe is generally cloven. This is a good practice when the ridges are ſteep, as all of them were formerly. As wheat or barley are commonly ſown after peaſe, the land muſt be ploughed before winter. Gathering is the moſt proper way of ploughing before winter, and this follows beſt after cleaving. But if the ridges be not high, caſting is the beſt method of ploughing for peaſe; or, if the ridges be flat and narrow, the land may be ploughed in the ordinary way, reverſing the former ploughing, and turning the furrows into the crowns. Though peaſe are generally the loweſt-priced grain, yet ſometimes they riſe to a great price, when the prices of other grains are moderate. This makes the ſaving of ſeed an article of great importance. By ſowing in drills, one firlot will ſerve for an acre as compleatly as four in the broad caſt-way: But the advantages of drilling fall to be conſidered afterwards.

Of the Culture of Beans.

What has been ſaid with regard to the culture of peaſe, may be applied to beans. However, it is neceſſary to obſerve, that the bean puſhes its roots further down than the pea; and therefore requires a deeper ſoil. The lands in Scotland, where beans are moſt commonly ſown, and where they ſucceed beſt, are deep and wet clays.

In ſome lands, the crops of beans are very great, and almoſt as valuable as any grain. There is no crop ſucceeds better in the drill-huſbandry than a crop of beans.

Of the Culture of Rye-graſs.

Rye-grass is the moſt common of all the artificial graſſes cultivated in Scotland, and not the leaſt valuable. It is a fibrous-rooted plant, and binds the ſoil; this circumſtance has led many to think, that it greatly impoveriſhes land. However, the culture of this graſs is attended with ſeveral peculiar advantages. It deſtroys weeds, particularly the quickening-graſs, and grows upon ſoils which will not anſwer for any of the other artificial graſſes. A ſhallow, wet, ſpungy ſoil, or one which has a mixture of moſs in it, is unfit for clover of every kind; but experience ſhows, that rye-graſs, when unmixed with clover, will ſucceed upon any of theſe ſoils.

Rye-graſs is uſually ſown along with a crop of barley or oats. When ſown along with barley, the field ſhould be rolled, or well harrowed, to preſerve the ſap at the dry ſeaſon of the barley-ſeed. This precaution is not ſo neceſſary, when the rye-graſs is ſown along with oats; becauſe the land on which oats are ſown is generally firmer, the ſowing ſeaſon is earlier, and conſequently not ſo liable to be too dry.

This graſs ſeldom hurts the crop of corn. On the contrary, when the ſoil is looſe and open, it makes it firm, and prevents the corn from lodging.

Though the common method is to ſow rye-graſs with corn, yet, when the land is poor, it is better to ſow it by itſelf, and ſtill better to ſummer-fallow, and ſow it in autumn. But, as the land by fallowing is made open and looſe, and as the ploughing and ſowing are near the rainy ſeaſon, cattle ought not to be allowed to paſture upon it during the winter, except in the time of hard froſt. Even when ſown in the ſpring, the farmer ſhould not allow much paſturing on it, eſpecially in wet weather. But, if ſown by itſelf, cattle may ſafely paſture upon it in the winter, as the roots, having nothing to obſtruct their progreſs, penetrate deeper, and ſpread wider, than when any other grain grows along with it. This practice, however, can only be followed with ſafety in very clean land; otherwiſe weeds are apt to riſe along with it, and prevent the ſurface from being covered; which of courſe will keep the ſoil open.

Rye-graſs is ſometimes ſown for hay, and ſometimes for paſture. When for hay, from two to four firlots are commonly ſown upon an acre.

Rye-graſs riſes very early in the ſpring, and, if the ſoil be dry and warm, affords good paſture all the winter. It is very hardy, ſtands the froſt, and, if continued in paſture, does not wear out in many years. The beſt way of managing it is, to eat it down in the ſpring and beginning of ſummer, and then to let it reſt till autumn. When allowed to get up in ſummer, it runs to ſeed, and becomes diſagreeable to the cattle. Beſides, by this method of managing rye-graſs, a good crop may be expected in autumn.

When properly managed, rye-graſs makes very good hay; and there is ſuch a demand for the ſeed, that the farmer is often tempted to let it ſtand till the ſeed is perfected, and then to threſh it. When this is done, the hay can never be good; becauſe the ſap is exhauſted, the ſtalk becomes dry and withered, and affords little nouriſhment to cattle. The hay ought therefore to be always cut before the ſeed ripens. This practice not only makes the beſt hay, but is likewiſe of great advantage to the land; for, when plants are allowed to perfect their ſeeds, the land is much more exhauſted, than when they are cut before that period.

Of the Culture of Clover.

Though clover be uſed for the ſame purpoſes as rye-graſs, it is, however, a plant of a very different nature. It has a large tap-root, which penetrates the ſoil perpendicularly downward, and opens the earth and makes it free: The roots of clover cannot penetrate the ſoil, unleſs it be free and open. Hence, a dry, open, deep ſoil, free from quicken-graſs, is the moſt proper for this plant.

There are ſeveral kinds of clover cultivated in Scotland,

land, diſtinguiſhed by the colour of their flowers, *viz.* the red, the white, and the yellow. The red is the largeſt plant, has the ſtrongeſt ſtalk, and broadeſt leaves. The yellow ſometimes grows tall, but the ſtalk is ſmall. The white is the ſmalleſt plant, and is ſometimes called *hop-clover*, from the reſemblance its flowers bears to thoſe of the hop.

Both the ſeaſons and methods of ſowing clover are various. Moſt of the Engliſh writers recommend the autumn. It has frequently been tried, at this ſeaſon, in Scotland without ſucceſs. When ſown in ſpring, it anſwers much better in this country.

The common way of ſowing clover, both in Scotland and England, is along with wheat, oats, or barley, in the ſpring. This method is ſometimes attended with diſadvantages. The clover ſometimes hurts the corn, and the corn the clover. However, theſe diſadvantages are probably more than over-balanced by the corn's protecting the clover from drought when very young, which it is much expoſed to, eſpecially when ſown in the ſpring.

As the lodging of corn deſtroys all plants that are below; to prevent this, the corn ſown along with clover ought to be ſown thin, and the land made very clean of weeds.

Sometimes, in a wet ſeaſon, the clover gets a-top of the corn, and deſtroys the crop. This ſeldom happens when it is ſown with barley or wheat; becauſe it is much later in the ſeaſon when ſown with barley than when ſown with oats, and therefore is not ſo far advanced at harveſt; and the wheat is advanced ſo far before the clover-ſeed is ſown, that the clover can never get the better of it. To prevent the clover, then, from hurting the corn, it may be ſown early in the ſeaſon with wheat, or late in the ſeaſon with barley. The Thanet barley, from the ſtrength of its roots and ſtalk, is not ſo apt to lodge as the common barley; and, of courſe, it is the moſt proper kind to be ſown along with clover. But, as all kinds of barley are more apt to lodge than oats, and as the ſeaſon for ſowing oats is more proper for ſowing clover than the ſeaſon of ſowing barley, the farmer, when it is equally convenient for him, ſhould prefer the ſowing of clover with oats.

When clover is ſown with barley or oats, after theſe grains are ſown, and the land harrowed, the clover-ſeed is thin ſown, and then the land is again harrowed or rolled. When the clover is ſown with a crop of wheat, the clover is ſown in the ſpring, and afterwards the wheat is rolled. It is common to ſow clover-ſeed without any preparation given to the land; but it is better to harrow it before ſowing. The harrowing does no harm to the wheat, and it makes the roller cover the ſeed more effectually. Clover-ſeed may be ſown in the ſame manner amongſt oats or early-ſown barley. Some time after the corn has come up, the land may be harrowed, and the clover ſown. If the weather be dry, the different parts of the operation ſhould ſucceed one another as quickly as poſſible. The harrows ſhould be immediately followed by the ſower, and the ſower by the roller, to prevent the drought from penetrating too deep.

The Engliſh writers differ widely as to the quantity of clover-ſeed proper to be ſown on an acre. However, the farmers in Scotland, who ſow clover with oats or barley, find, that from 10 to 16 ℔. of red, or from 12 to 18 ℔. of white clover on the acre, produces a very good crop.

Clover, like rye-graſs, is ſometimes ſown for hay, ſometimes for paſture, and ſometimes for both. The red clover is the moſt proper for hay, the white for paſture; and, when both are intended, a mixture of the two anſwers beſt. When red clover is ſown without being mixed with any other kind, the farmer ought to bring his land into tillage again in two or three years: For, after the ſecond year, a crop of this kind of clover is of little value.

When white clover is ſown by itſelf, the farmer muſt not expect a crop of hay; for it ſeldom riſes to ſuch a height as to produce a good crop: But, to balance this, the field may be kept long in paſture, as this clover continues till wore out by the natural graſs of the ſoil.

When a mixture of the two are ſown, ſome crops of hay may be taken, and then the land may be allowed to lie ſome years longer for paſture. The red clover affords the crops of hay; and the white remains till the natural graſs riſes. In this caſe, there is commonly ſown upon the acre, from 8 to 12 ℔. of red clover, and from 6 to 8 of white. But theſe proportions may be varied according to the judgment of the farmer.

In Scotland, ſeldom more than one crop of hay in the ſeaſon ſucceeds. The ſecond crop is commonly ſo late, that it is very difficult to get the hay properly made. It may therefore be paſtured on, or cut green for cattle. When clover is cut green for cattle, it is a proper way to feed them upon a field that needs dung. This method is preferable to feeding them in ſtalls; it ſaves the expence of carrying out the dung, and procures to the land the benefit of the urine, which is a very rich manure.

Before concluding this article, it muſt be obſerved, that red clover, while green, is dangerous to black cattle and ſheep, when firſt given them, eſpecially if wet with dew or rain. They ought therefore to be allowed it only ſparingly at firſt, and brought to it by degrees. After being accuſtomed to it for a few days, the danger is over, and they may be allowed to uſe as much of it as they pleaſe.

Of the Culture of Clover mixed with Rye-graſs.

Red clover makes the beſt green forage for cattle. An acre of it will maintain more cattle than three or four acres of common graſs: But then it is not ſo proper for hay. Clover-hay is very troubleſome in making, and is not reckoned ſo good for feeding as ſome other kinds of hay. It likewiſe hurts the land, by encouraging the growth of quickening-graſs. To remedy theſe diſadvantages, it is common to ſow rye-graſs along with it. Clover, when mixed with rye-graſs, is eaſier made into hay; the hay itſelf is much better; and the rye-graſs, by covering the ſurface, prevents the growth of the quickening-graſs. The quantity ſown upon the acre in this way is from 8 to 12 ℔. of clover, and from 1 to 3 firlots of rye-graſs.

Of

Of the Culture of St-Foin.

The writers on agriculture reckon this grass preferable to clover in many respects: They say, that it produces a larger crop; that it does not hurt cattle when eaten green; that it makes better hay; that it continues four times longer in the ground; and that it will grow on land that will bear no other crop. These are great advantages: But, as we have so little of that kind of grass in Scotland, it cannot be expected that any directions can be given concerning the manner of cultivating it, founded upon experience. We must therefore confine ourselves to such facts as are mentioned by authors of the best credit.

St-foin has a very long tap-root, which is able to pierce very hard earth. The roots grow very large, and the larger they are, they penetrate to the greater depth; and hence it may be concluded, that this grass, when it thrives well, receives a great part of its nourishment from below the *staple* of the soil: of course, a deep dry soil is best for the culture of St-foin. When plants draw their nourishment from that part of the soil that is near the surface, it is not of much consequence whether their number be great or small. But the case is very different when the plants receive their food, not only near, but also deep below the surface. Besides, plants that shoot their roots deep are often supplied with moisture, when those near the surface are parched with drought.

To render the plants of St-foin vigorous, it is necessary that they be sown thin. The best method of doing this is by a drill; because, when sown in this manner, not only the weeds, but also the supernumerary plants, can easily be removed. It is several years before St-foin comes to its full strength; and the number of plants sufficient to stock a field, while in this imperfect state, will make but a poor crop for the first year or two. It is therefore necessary that it be sown in such a manner as to make it easy to take up plants in such numbers, and in such order, as always to leave in the field the proper number in their proper places. This can only be done with propriety, by sowing the plants in rows by a drill. Supposing a field to be drilled in rows at ten inches distance, the partitions may be hand-hoed, and the rows dressed in such a manner as to leave a proper number of plants. In this situation the field may remain two years; then one fourth of the rows may be taken out in pairs, in such a manner as to make the beds of fifty inches, with six rows in each, and intervals of thirty inches, which may be ploughed. Next year, another fourth of the rows may be taken out in the same manner, so as to leave double rows with partitions of ten inches, and intervals of thirty: All of which may be hoed at once or alternately, as it may be found most convenient.

The great quantity of this grass which the writers on this subject assure us may be raised upon an acre, and the excellency and great value of the hay made of it, should induce farmers to make a complete trial of it, and even to use the spade in place of the hoe, or hoe-plough, if necessary.

The plants taken up from a field of St-foin may be set in another field; and if the transplanting of this grass succeeds as well as the transplanting of lucern has done with Mr Lunin de Chateauvieux, the trouble and expence will be sufficiently recompensed by the largeness of the crops. In transplanting, it is necessary to cut off great part of the long tap-root: this will prevent it from striking very deep into the soil, and make it push out large roots in a sloping direction from the cut end of the tap-root. St-foin managed in this manner, will thrive even on shallow land that has a wet bottom, provided it be not overstocked with plants.

Whoever inclines to try the culture of this grass in Scotland, should take great pains in preparing the land, and making it as free from weeds as possible.

Of the Culture of Lucern.

The writers on agriculture, ancient as well as modern, bestow the highest encomiums upon this grass, as affording excellent hay, and producing very large crops. Lucern remains at least ten or twelve years in the ground, and produces about eight tons of hay upon the Scots acre. There is but little of it cultivated in Scotland. However, it has been tried in several parts of this country; and it is found, that, when the seed is good, it comes up very well, and stands the winter-frost. But the chief thing that prevented this grass from being more used in this country, is the difficulty of keeping the soil open, and free from weeds. In a few years the surface becomes so hard, and the turf so strong, that it destroys the lucern before the plants have arrived at their greatest perfection: so that we cannot hope to cultivate lucern with success, unless we fall upon some method of destroying the natural grass, and prevent the surface from becoming hard and impenetrable. This cannot be done effectually by any other means than horse-hoeing. This method was first proposed by Mr Tull, and afterwards practised successfully by M. de Chateauvieux near Geneva. It may be of use therefore to give a view of that gentleman's method of cultivating lucern.

He does not mention any thing particular as to the manner of preparing the land; but only observes in general, that no pains should be spared in preparing it. He tried the sowing of lucern both in rows upon the beds where it was intended to stand, and likewise the sowing it in a nursery, and afterwards transplanting it into the beds prepared for it. He prefers transplanting; because, when transplanted, part of the tap-root is cut off, and the plant shoots out a number of lateral branches from the cut part of the root, which makes it spread its roots nearer the surface, and consequently renders it more easily cultivated: besides, this circumstance adapts it to a shallow soil, in which, if left in its natural state, it would not grow.

The transplanting of lucern is attended with many advantages. The land may be prepared in the summer for receiving the plants from the nursery in autumn; by which means the field must be in a much better situation than if the seed had been sown upon it in the spring. By transplanting, the rows can be made more regular, and the intended distances more exactly observed; and consequently

quently the hoeing can be performed more perfectly, and with lefs expence. M. Chateauvieux likewife tried the lucern in fingle beds three feet wide, with fingle rows; in beds three feet nine inches wide, with double rows; and in beds four feet three inches wide, with triple rows. The plants in the fingle rows were fix inches afunder, and thofe in the double and triple rows were about eight or nine inches. In a courfe of three years he found, that a fingle row produced more than a triple row of the fame length. The plants of lucern, when cultivated by tranfplantation, fhould be at leaft fix inches afunder, to allow them room for extending their crowns.

He further obferves, that the beds or ridges ought to be raifed in the middle; that a fmall trench, two or three inches deep, fhould be drawn in the middle; and that the plants ought to be fet in this trench, covered with earth up to the neck. He fays, that if the lucern be fown in fpring, and in a warm foil, it will be ready for tranfplanting in September; that, if the weather be too hot and dry, the tranfplanting fhould be delayed till October; and that, if the weather be unfavourable during both thefe months, this operation muft be delayed till fpring. He further directs, that the plants fhould be carefully taken out of the nurfery, fo as not to damage the roots; that the roots be left only about fix or feven inches long; that the green tops be cut off within about two inches of the crown; that they be put into water as foon as taken up, there to remain till they are planted; and that they fhould be planted with a planting-ftick, in the fame manner as cabbages.

He does not give particular directions as to the times of horfe-hoeing; but only fays in general, that the intervals fhould be ftirred once in the month during the whole time that the lucern is in a growing ftate. He likewife obferves, that great care ought to be taken not to fuffer any weeds to grow among the plants, at leaft for the firft two or three years; and for this purpofe, that the rows, as well as the edges of the intervals where the plough cannot go, fhould be weeded by the hand.

Of the Culture of Potatoes.

The potatoe is one of the moft ufeful roots that are cultivated in this country, and is raifed in a very different manner from any of the other roots. It has a number of *eyes* in it, each of which produce a feparate plant. The largeft potatoes are the beft for feed; becaufe, when cut according to the eyes, and properly fown, the plants are not in danger of crowding each other. The plant fends out roots in every direction to a confiderable diftance, and upon thefe the potatoes are formed.

There are feveral kinds both of the white and red potatoes. They fucceed beft in a light dry foil; and though there be but a fmall mixture of loam in it, if tolerably rich and properly cultivated, it feldom fails to produce a good crop. But a good crop is not to be expected from a ftiff wet foil, unlefs it be laid up in ridges fo as to make it dry, and a confiderable quantity of dung laid on to render it open.

When the crop of potatoes is the chief point in view, the land fhould have a ploughing before winter, efpecially if the foil be not very free and open. If dung be neceffary, the proper time for laying it on is before this ploughing. When the potatoes are to be planted, which may be done any time in March or beginning of April; the land muft again be ploughed in narrow furrows, and the potatoes dropped into every fecond furrow. But if the land be open and very loofe, they may be dropped into every furrow; and as the plough opens the furrow for the fecond row, it buries the firft row at a proper depth. The furrow fhould not be very deep; and two horfes are fufficient. It is better in this cafe to make the horfes go a-breaft than in a line; becaufe, as one of them only goes in the furrow, the potatoes are not fo liable to be hurt or difplaced. This method of planting them by the plough is greatly preferable to the *dibble* or planting-ftick.

When a fmall quantity is intended to be cultivated, they may be planted with the fpade. A fmall crofs-trench or furrow fhould be opened with the fpade at the end of the ridge. Into this furrow drop the potatoes at proper diftances; and, in making the next furrow, the roots laid in the firft will be covered in the fame manner as is done by the plough.

According to the diftance of the rows made by the plough, the diftance of the plants in the rows fhould be regulated: One plant in a fquare foot is fufficient to allow them to be properly hoed. When planted in every fecond furrow ploughed narrow, the rows will be about 12 or 14 inches afunder. The plants may be placed at the fame diftance in the rows.

It is unneceffary to harrow the land after the potatoes are planted: This operation may be delayed till the weeds appear, which gives the farmer an opportunity of deftroying them without any additional labour. Tho' potatoes be planted early in the fpring, or even before winter, they do not come up till May. Before that time the weeds are far advanced; and, if they be not deftroyed by the harrows, the land muft be hoed. Indeed, the goodnefs of the crop depends fo much upon preventing the weeds from coming to any height, that it is neceffary to hoe potatoes frequently. If the rows be wide, a kind of breaft-hoe may be ufed to throw the earth a little on each fide, by which it will be raifed about the plants.

When two or three plants are in one piece, as often happens in light land, they fhould be cleaned with the hand at the root, and only one ftalk left to each plant. This not only gives air to the roots, but alfo prevents much of the nourifhment from going into the ftalks.

When the hufk that contains the feed, or the *apple*, as it is commonly called, is completely formed, the ftalks may be cut down and given to cows. Milk-cows have been tried with this food; they eat it very freely, and it gives no bad flavour to the milk.

The time of taking up potatoes is commonly regulated by the market. But, if nothing be in view but the largenefs of the crop, they ought to ftand till October, or as long as they can be conveniently taken up before the froft fets in. The moft expeditious method of taking them up is by the plough: Eight or nine perfons to attend

attend the plough are ſufficient. After the field is once ploughed, it ought to be harrowed, by which ſome of the potatoes will be raiſed; and, when theſe are gathered, it ſhould be ploughed a ſecond time.

Of the Culture of Turnips.

Turnips have been long cultivated in England, and, in ſome places, are eſteemed one of the moſt valuable crops that can be raiſed. The trials made in Scotland have been very ſucceſsful, which gives great encouragement to proceed.

The goodneſs of the crop depends more on the openneſs of the ſoil than its richneſs. Land newly broke up is particularly proper for turnips. Though this kind of land be naturally poor, yet, with the aſſiſtance of a little dung, it ſeldom fails to produce an excellent crop. The land intended for turnips ſhould be ploughed and laid up in ridges before winter, that it may have the benefit of the froſt. This winter-ploughing, however, is unneceſſary when the land is dry and light: The ſpring is early enough for this kind of land. It may get a ſecond ploughing in the end of May, and a third in the middle or end of June, when the ſeed is to be ſown. Though three ploughings are here mentioned, no particular number is intended; for the land ought to be ploughed over and over, till it be thoroughly pulveriſed. If dung be uſed, it ſhould be well rotted, and laid on before the laſt ploughing.

Turnip-ſeed is uſually ſown by the hand; and about half a pound is ſufficient for an acre. It ſhould be mixed with ſand, that it may be ſcattered the more equally. But ſowing by a drill is better than ſowing by the hand, as, in this way, the plants can be more eaſily hoed, and thinned. Turnips ſhould be hoed as ſoon as the plants can be eaſily diſtinguiſhed; for they grow quickly, and, if they meet with any obſtruction from weeds, they are apt to become ſickly; and, when this happens, they can never be recovered ſo as to produce a good crop.

Turnips may be cultivated with great ſucceſs by the new huſbandry. They have been tried in ſingle, double, and triple rows, and, in alleys, from four to ſix feet wide, according to the ſituation of the land. The poorer the land is, or the more difficult to be reduced, the alleys ought to be the wider. After the ridges are formed, the turnip ſhould be drilled upon the crowns; and, as ſoon as they come up, and are paſt all danger from the fly, they ſhould be horſe-hoed.

The turnip is proper food, either for ſheep or black cattle. When the land is dry and needs manure, the ſheep may be folded on it: But the fold muſt be removed every day; for it is improper to allow them to eat more at once than they can conſume in that time. When the land is wet, or very rich, the turnip may be pulled, and the ſheep fed with them on another field that needs manure. But, when deſigned for black cattle, they muſt be pulled up and given them, either in ſtalls or in another field, as the farmer ſhall find moſt convenient.

Of the Culture of Carrot.

The carrot is but rarely cultivated in our fields: Indeed, the preſent market does not encourage the cultivation of this plant. But they have lately been found to be excellent food for horſes; they eat them greedily, and are well fed by them. Carrots are not difficult to raiſe; a very ſmall field is ſufficient, and the trial may eaſily be made by any farmer, at a very ſmall expence.

The beſt crops of carrots, in our gardens, are produced by trenching. When the ſoil is hard below, though it be well dunged, it does not produce a good crop. Whenever the roots reach the hard ſoil, they become forked, *i. e.* the roots divide, which prevents them from growing large. Trenching makes the earth deep, and, by throwing what was on the ſurface into the bottom of the trench, lays good ſoil below for the roots to extend themſelves into. Something like this muſt be done in our fields before we can expect a good crop.

M. de Chateauvieux tried to raiſe a crop of carrots by the horſe-hoeing huſbandry, and was very ſucceſsful. He ſowed them in beds ſix feet broad, on the 4th of May. He ſtirred the alleys with the ſpade on the 15th and 27th of July, and a third time on the 6th of September. They were digged up on the 8th of November, meaſured from 18 to 25 inches in length, and from two to four in diameter, and weighed from 25 to 33 ounces.

Land that has a hard bottom of clay or till is improper; and it is vain to expect that ſuch land can be prepared for carrots by the plough, without great trouble and expence. But, when land has a ſoft bottom, a good crop of carrots may be raiſed at a ſmall expence by horſehoeing.

As the ſeed, in this country, muſt be ſown in March, the land ſhould get a ploughing before winter, and be laid out in beds or ridges of the breadth propoſed when the carrots are to be ſown; the furrows betwixt theſe ridges ſhould be made as deep as poſſible, becauſe it is upon theſe furrows that the rows of carrots are to be ſown. A ſecond ploughing in winter ſhould reverſe the firſt, and turn the furrows into crowns; and, before the carrots are ſown, one bout of the plough may raiſe the crown of the ridge ſtill higher. Upon theſe crowns the ſeed muſt be ſown out of the hand, into a ſmall trench, drawn as ſtraight as poſſible, and covered with a rake.

When the weeds firſt appear, the remaining part of the ridges may be ploughed out, turning the earth to the rows, and taking care not to go ſo near as to cover the plants. Before the ſeed is ſown, which is ſome time in March, inſtead of ploughing the whole ridge, the plough ſhould only go once about on the crown, to prevent the bad effects of too much moiſture.

As ſoon as the plants can be eaſily diſtinguiſhed, they ſhould be hand-hoed, and thinned where they ſtand too thick; and after this the alleys muſt be regularly hoed, as directed in the culture of turnips.

It is natural to expect, that carrots raiſed in this way ſhould be freer from worms, and much better every way,

way, than thofe raifed in our gardens, except fuch as are fown upon newly trenched ground.

SECT. VI. PRINCIPLES AND ADVANTAGES OF THE NEW HUSBANDRY.

THE general principles of the new hufbandry may be reduced to two, *viz.* the promoting the growth of plants by hoeing, and the faving of feed; both of which are equally profitable to the farmer.

But, before illuftrating thefe principles and advantages, it will be neceffary to defcribe the inftruments that are commonly ufed in cultivating land by this new method.

Plate IX. fig. 1. is a marking plough. The principal ufe of this plough is to ftreight and regulate the ridges. The firft line is traced by the eye, by means of three poles, placed in a ftreight line. The plough draws the firft furrow in the direction of this line; and, at the fame time, with the tooth A, fixed in the block of wood near the end of the crofs-poll or flider B B, marks the breadth of the ridge at the diftance intended. The ploughman next traces the fecond line or rutt made by the tooth, and draws a fmall furrow along it; and continues in this manner till the whole field is laid out in ftreight and equidiftant ridges.

—Fig. 2. is a plough for breaking up lee, or turning up the bottom of land when greatly exhaufted. By its conftruction, the width and depth of the furrows can be regulated to a greater certainty than by any other hitherto known in this country. Its appearance is heavy; but two horfes are fufficient to plough with it in ordinary free land; and only four are neceffary in the ftiffeft clay-foils. This plough is likewife eafily held and tempered. A, is the fword fixed in the fizers B, which runs thro' a mortoife at the end of the beam E, and regulates the depth of the furrow, by raifing or depreffing the beam; it is fixed by putting the pin D, through the beam and fword, and is moveable at E.

—Fig. 3. is a jointed break harrow with 24 teeth fhaped like coulters, and ftanding at about an angle of 80 degrees. By this inftrumentthe land is finely pulverifed, and prepared for receiving the feed from the drill. It requires four horfes in ftiff, and two in open land. This harrow is likewife ufed for levelling the ridges; this is done by preffing it down by the handles where the ridge is high, and raifing it up when low.

—Fig. 4. is an angular weeding harrow, which may follow the break when neceffary. The feven hindmoft teeth fhould ftand at a more acute angle than the reft, in order to collect the weeds, which the holder can drop at pleafure, by raifing the hinder part, which is fixed to the body of the harrow by two joints.

—Fig. 5. is a pair of harrows with fhafts. This harrowis ufed for covering the feed in the drills, the horfe going in the furrow.

—Fig. 6. is a drill-plough, conftructed in fuch a manner as to fow at once two rows of beans, peafe, or wheat. This machine is eafily wrought by two horfes. A, is the happer for containing the feed; B, circular boxes for receiving the feed from the happer; C C, two fquare boxes which receive the feed from fmall holes in the circular boxes, as they turn round; and laft of all, the feed is dropped into the drills through holes in the fquare boxes, behind the coulters D. The cylinder E follows, which, together with the wheel F, regulates the depth of the coulters, and covers the feed; the harrow G comes behind all, and covers the feed more completely. H H, two fliders, which, when drawn out, prevent the feed from falling into the boxes; and, I, is a ketch which holds the rungs, and prevents the boxes from turning, and lofing feed at the ends of the ridges.

—Fig. 7. is a fingle hoe-plough of a very fimple conftruction, by which the earth, in the intervals, is ftirred and laid up, on both fides, to the roots of the plants, and, at the fame time, the weeds are deftroyed. A A the mold-boards, which may be raifed or depreffed at pleafure, according as the farmer wants to throw the earth higher or lower upon the roots.

Advantages of Horfe-hoeing.

THE advantages of tillage before fowing have already been pointed out. In this place we muft confine ourfelves to the utility of tillage after fowing. This kind of tillage is moft generally known by the name of *horfe-hoeing*.

Land fowed with wheat, however well it may be cultivated in autumn, finks in the winter; the particles get nearer together, and the weeds rife; fo that in fpring, the land is nearly in the fame fituation as if it never had been ploughed. This, however, is the feafon when it fhould branch and grow with moft vigour; and confequently ftands moft in need of ploughing or hoeing, to deftroy the weeds, to fupply the roots with frefh earth, and, by dividing anew the particles of the foil, to allow the roots to extend and collect nourifhment.

It is well known, that, in gardens, plants grow with double vigour after being hoed or tranfplanted. If plants growing in arable land could be managed with eafe and fafety in this manner, it is natural to expect, that their growth would be promoted accordingly. Experience fhows, that this is not only practicable, but attended with many advantages.

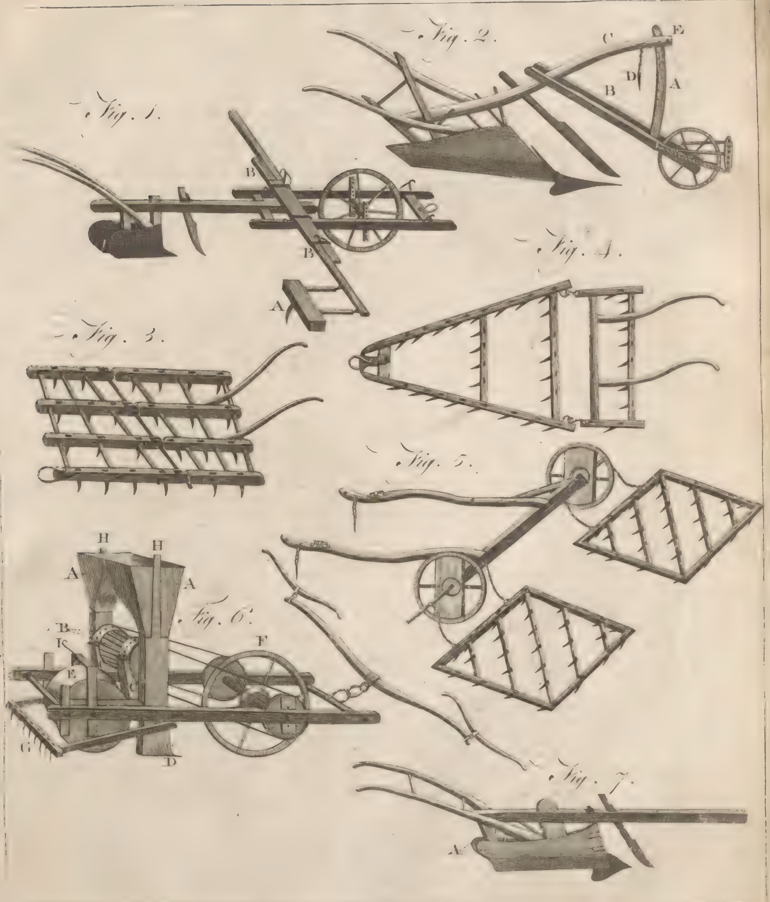
In the operation of hoeing wheat, though fome of the roots be moved or broke, the plants receive no injury; for this very circumftance makes them fend forth a greater number of roots than formerly, which enlarge their pafture, and confequently augment their growth.

Sickly wheat has often recovered its vigour after a good hoeing, efpecially when performed in weather not very hot or dry.

Wheat, and fuch grain as is fown before winter, requires hoeing more than oats, barley, or other grain fown in the fpring; for, if the land has been well ploughed before the fowing of fpring-corn, it neither has time to harden nor to produce many weeds, not having been expofed to the winter's fnow and rain.

Of

Plate. IX.



J. Bell Sculp.

Of Sowing.

As, in the practice of the new hufbandry, plants grow with greater vigour than by the old method, the land fhould be fowed thinner. It is this principle of the new hufbandry that has been chiefly objected to; for, upon obferving the land occupied by a fmall number of plants, people are apt to look upon all the vacant fpace as loft. But this prejudice will foon be removed, when it is confidered, that, in the beft land cultivated in the common method, and fown very thick, each feed produces but one or two ears; that, in the fame land fown thinner, every feed produces two or three ears; and that a fingle feed fometimes produces eighteen or twenty ears.

In the common method, as there are many more plants than can find fufficient nourifhment, and as it is impoffible to affift them by hoeing, numbers die before they attain maturity, the greateft part remain fickly and drooping; and thus part of the feed is loft. On the contrary, in the new method, all the plants have as much food as they require; and as they are, from time to time, affifted by hoeing, they become fo vigorous as to equal in their production the numerous, but fickly plants cultivated in the common method.

Of Hoeing.

The new hufbandry is abfolutely impracticable in lands that are not eafily ploughed. Attempting to cultivate land according to this hufbandry, without attending to this circumftance, that it is practicable in no land, excepting fuch as have already been brought into good tilth by the old method, has gone far to make it contemptible in many places.

When a field is in good tilth, it fhould be fown fo thin as to leave fufficient room for the plants to extend their roots. After being well ploughed and harrowed, it muft be divided into rows, at the diftance of 30 inches from one another. On the fides of each of thefe rows, two rows of wheat muft be fowed fix inches diftant from each other. By this means there will be an interval of two feet wide betwixt the rows, and every plant will have room enough to extend its roots, and to fupply it with food. The intervals will likewife be fufficient for allowing the earth to be hoed or tilled without injuring the plants in the rows.

The firft hoeing, which fhould be given before the winter, is intended to drain away the wet, and to difpofe the earth to be mellowed by the frofts. Thefe two ends will be anfwered by drawing two fmall furrows at a little diftance from the rows, and throwing the earth taken from the furrows into the middle of the intervals. This firft hoeing fhould be given when the wheat is in leaf.

The fecond hoeing, which is intended to make the plants branch, fhould be given after the hard frofts are over. To do this with advantage, after ftirring the earth a little, near the rows, the earth which was thrown in the middle of the intervals fhould be turned back into the furrows. This earth, having been mellowed by the winter, fupplies the plants with excellent food, and makes the roots extend.

The third hoeing, which is intended to invigorate the ftalk, fhould be given when the ears of the corn begin to fhew themfelves. This hoeing may, however, be very flight.

But the laft hoeing is of the greateft importance, as it enlarges the grain, and makes the ears fill at their extremities. This hoeing fhould be given when the wheat is in bloom; a furrow muft be drawn in the middle of the interval, and the earth thrown to the right and left on the foot of the plants. This fupports the plants, prevents them from being laid, and prepares the ground for the next fowing, as the feed is then to be put in the middle of the ground that formed the intervals.

By this fucceffive tillage, or hoeing, good crops will be obtained, provided the weather is not very unfavourable.

But as ftrong, vigorous plants are longer before they arrive at maturity, corn raifed in the new way is later in ripening than any other, and muft therefore be fown earlier.

In order to prepare the intervals for fowing again, fome well-rotted dung may be laid in the deep furrows made in the middle of the intervals; and this dung muft be covered with the earth that was before thrown towards the rows of wheat. But, if the land does not require mending, the deep furrow is filled without any dung. This operation fhould be performed immediately after harveft, that there may be time to give the land a flight ftirring before the rows are fowed; which fhould occupy the middle of the fpace which formed the intervals during the laft crop. The intervals of the fecond year take up the fpace occupied by the ftubble of the firft.

Suppofing dung to be neceffary, which is denied by many, a very fmall quantity is fufficient; a fingle layer, put in the bottom of each furrow, will be enough.

Summary of the Operations neceffary in executing the New Hufbandry with the Plough.

1. It is indifpenfibly neceffary that the farmer be provided with a drill and hoe-plough.

2. The new hufbandry may be begun either with the winter or fpring corn.

3. The land muft be prepared by four good ploughings, given at different times, from the beginning of April to the middle of September.

4. Thefe ploughings muft be done in dry weather, to prevent the earth from kneading.

5. The land muft be harrowed in the fame manner as if it were fowed in the common way.

6. The rows of wheat fhould be fowed very ftraight.

7. When the field is not very large, a line muft be ftrained acrofs it, by which a rill may be traced with a hoe for the horfe that draws the drill to go in; and, when the rows are fown, fifty inches muft be left betwixt each rill. But, when the field is large, ftakes at five feet diftance from each other, muft be placed at the two ends. The workman muft then trace a fmall furrow, with

with a plough that has no mold-board, for the horſe to go in that draws the drill, directing himſelf with his eye by the ſtakes.

8. The ſowing ſhould be finiſhed about the end of September, or beginning of October.

9. The furrows muſt be traced the long way of the land, that as little ground as poſſible may be loſt in head-lands.

10. The rows, if it can be done, ſhould run down the ſlope of the land, that the water may get the eaſier off.

11. The ſeed-wheat muſt be plunged into a tub of lime-water, and ſtirred, that the light corn may come to the ſurface and be ſkimmed off.

12. The ſeed muſt next be ſpread on a floor, and frequently ſtirred, till it is dry enough to run through the valves of the happer of the drill.

13. To prevent ſmut, the ſeed may be put into a lye of aſhes and lime.

14. After the happers of the drill are filled, the horſe muſt go ſlowly along the furrow that was traced. That a proper quantity of ſeed may be ſown, the aperture of the happer muſt be ſuited to the ſize of the grain.

15. As the drill is ſeldom well managed at firſt, the field ſhould be examined after the corn has come up, and the deficiencies ſupplied.

16. Stiff lands that retain the wet, muſt be ſtirred or hoed in October. This ſhould be done by opening a furrow in the middle of the intervals, and afterwards filling it up by a furrow drawn on each ſide, which will raiſe the earth in the middle of the intervals, and leave two ſmall furrows next the rows, for draining off the water, which is very hurtful to wheat in winter.

17. The next ſtirring muſt be given about the end of March, with a light plough. In this ſtirring, the furrows made to drain the rows muſt be filled up by earth from the middle of the intervals.

18. Some time in May, the rows muſt be evened, which, though troubleſome at firſt, ſoon becomes eaſy, as the weeds are ſoon kept under by tillage.

19. In June, juſt before the wheat is in bloom, another ſtirring muſt be given with the plough. A deep furrow muſt be made in the middle of the intervals, and the earth thrown upon the ſides of the rows.

20. When the wheat is ripe, particular care moſt be taken in reaping it, to trample as little as poſſible on the ploughed land.

21. Soon after the wheat is carried off the field, the intervals muſt be turned up with the plough, to prepare them for the ſeed. The great furrow in the middle muſt not only be filled, but the earth raiſed as much as poſſible in the middle of the intervals.

22. In September, the land muſt be again ſowed with a drill, as above directed.

23. In October, the ſtubble muſt be turned in for forming the new intervals; and the ſame management muſt be obſerved as directed in the firſt year.

We pretend not to determine whether the old or new huſbandry be preferable in every country.

With regard to this point, the climate, the ſituation of particular land, ſkill and dexterity in managing the machinery, the comparative expence in raiſing crops, and many other circumſtances, muſt be accurately attended to before a determination can be given. One obſervation, however, may be made in favour of the new huſbandry:—Though the particular modes of cultivating land by it are perhaps too limited to be univerſally adopted; yet it has been of great uſe in raiſing ſuſpicions concerning the old method, and in turning the views of philoſophers and farmers towards improving in general. Many real improvements in agriculture have been the conſequences of theſe ſuſpicions; and as this ſpirit of inquiry remains in full vigour, particularly in our own country, a ſolid foundation is laid for expecting ſtill further improvements in this uſeful art.

AGRIFOLIUM, in botany. See AQUIFOLIUM.

AGRIMONIA, AGRIMONY, in botany, a genus of the dodecandria digynia claſs. There are three ſpecies of this genus, *viz.* the eupatoria, repens, and agrimonoides; of which the eupatoria only is a native of Britain. The calix of the eupatoria is quinquedentated; it has five petals, and two ſeeds in the bottom of the calix. It is ſaid to be good in obſtructions of the liver, *&c.*

AGRIMONOIDES, in botany, the trivial name of a ſpecies of the agrimonia.

AGRIMONY. See AGRIMONIA.

Hemp AGRIMONY. See EUPATORIUM.

Water-hemp-AGRIMONY. See BIDENS.

AGRIOCINARA, in botany. See CINARA.

AGRIPPA, in midwifery, a term applied to children brought forth with their feet foremoſt. See MIDWIFERY.

AGR

AGRIUM, in nat. hiſt. See NATRUM.

AGROM, the name of a diſeaſe incident to the inhabitants of the Eaſt-Indies, by which their tongues chap and cleave in different places.

AGROPOLI, a ſmall town in the kingdom of Naples, and province of the Hither Principato.

AGROSTEMMA, or COCKLE, in botany, a genus of the decandria pentagynia claſs. The calix is monophyllous; the petals are five, and ungulated; and the capſule one-valved. There are four ſpecies of the agroſtemma, *viz.* the githago, a native of Britain; the cœlirosa, a native of Sicily; the coronaria, a native of Italy; and the flos Jovis, a native of Switzerland.

AGROSTIS, *bent-graſs*, in botany, a genus of the triandria digynia claſs. The calix has two valves, terminated by a beard or aun. There are fifteen ſpecies of the agroſtis, eight of which are natives of Britain.

AGROSTOGRAPHIA, signifies the history or description of grasses.

AGRYPNIA, a term with physicians for watching, or an inaptitude to sleep.

AGUALVA, in geography, the name of a river of Portugal, and of a town in the island of Tercera.

AGUAPECACA, in ornithology, a barbarous name of a species of the tetrao. See TETRAO.

AGUARA-QUIYA, in botany, a barbarous name of the solanum. See SOLANUM.

AGUARA-PONDA, in botany, a barbarous name of a species of the viola. See VIOLA.

AGUARICO, a river of S. America, which, arising in the mountains of Cordeleras, falls into the river of the Amazons.

AGUBER, a river of Africa, in the kingdom of Fez, which loses itself in the Beber. See BEBER.

AGUE, a general name for all kinds of periodical fevers. See MEDICINE, title, *Of agues or intermittents.*

AGUE-*tree*, in botany. See SASSAFRAS.

AGUEPERSE, a town of France, situated in the Lyonnois, about fifteen miles north of Clermont.

AGUER, the name of Santa-croix, before it fell into the hands of the Portuguese.

AGUGLIA, a name used by some travellers for the obelisks of Egypt. See OBELISK.

AGUIGAN, one of the Marian islands. See MARIAN *islands.*

AGUILAR, a town of Spain, in the province of Navarre, about twenty-four miles west of Estella.

AGUILAR *Del Campo*, a town of Old Castile, with the title of marquisate, about fifteen leagues north of the city of Burgos.

AGUL, in botany, a synonime of the hedysarum. See HEDYSARUM.

AGURAH, in Jewish antiquity, the name of a silver coin, otherwise called *gerah*, and *keshita.*

AGURANDE, a fortified town of France, in the country of Berry, about four leagues south of Chartres.

AGUSADURA, AGUSAGE, in our old customs, a certain fee paid by vassals to their lord, for the sharpening of their plough-tackle.

AGUTI, in zoology, the trivial name of a species of the mouse, belonging to the mammalia glires of Linnæus. See MUS.

AGUTI-GUEPA, in botany. See SAGITTARIUM.

AGUTI-TREVA, in botany, a barbarous name of a species of the citrus. See CITRUS.

AGUTIGVEPO-OBI, in botany, a synonime of the thalia. See THALIA.

AGUZ, a river of Africa, in the empire of Morocco, and province of Duquela.

AGWANA, a kingdom of Africa, upon the golden coast, lying northwards of Aquemboe.

AGYEI, in antiquity, a kind of obelisks, sacred to Apollo, erected in the vestibles of houses, by way of security.

AGYNIANI, in church-history, a sect of heretics who condemned all carnal commerce with women.

AGYRTÆ, in Grecian antiquity, a kind of strolling vagabonds, not unlike our modern gypsies.

AHÆTULLA, the trivial name of a species of the coluber, belonging to the order of amphibia serpentes. See COLUBER.

AHALOTH. See XYLO-ALOES.

AHANIGER, in zoology. See ACUS.

AHAUSEN, in geography, the same with Ahuys. See AHUYS.

AHICCYATLI, in zoology, the Indian name of a serpent resembling the rattle-snake, only it wants the rattles. See COLUBER.

AHMELLA, in botany, See BIDENS.

AHOUAI, in botany, a synonime, and also the trivial name of a species of the cerbera, See CERBERA.

AHRENSBOECK, a fortress of Holstein, on the road from Lubec to Kiel.

AHUAS, a considerable town and district of Persia, in the province of Khurestan or Chusistan.

AHUN, a town of France, in the higher Marche, situated upon the river Creuse.

AHUS, a town of Germany, in the bishoprick of Munster, capital of a considerable district.

AHUYS, a sea-port town of Sweden, in the province of Gothland, situated in 32. 14. E. long. and 56. 0. N. lat.

AIA, the name of a small river of Italy, which falls into the Tiber, near the village Magliano.

AIAIA, in ornithology, a species of the platalea, a bird of the order of grallæ. See PLATALEA.

AJAJOUNI, the name given by the Turks to a town of Lesser Asia, otherwise called *Hagia.*

AJAN, or AYAN, the name of a large maritime country of Africa, lying southwards of the mouth of the Red-sea, the natives of which are white.

AJANTIA, in antiquity, an annual festival celebrated in the island of Salamis in honour of Ajax.

AJASALOUE, the modern name by which the Turks call Ephesus. See EPHESUS.

AJAX, in Grecian antiquity, a kind of dance representing the madness of Ajax after his defeat by Ulysses.

AJAZZO, the name of two towns, the one in the island of Corsica; and the other in Lesser Asia, about fifty miles west of Aleppo.

AICHMALOTARCHA. See the article ÆCHMALOTARCHA.

AICHSTAT, a city of Germany in the circle of Franconia, about fourteen miles N. W. of Ingolstat.

AID, in a general sense, denotes any kind of assistance given by one person to another.

AID, or AYDE, in law, denotes a petition made in court to call in help from another person who has interest in land, or any other thing contested.

AID-*de-camp*, in military affairs, an officer employed to receive and carry the orders of a general.

AID-*major*, the French term for an adjutant. See the article ADJUTANT.

AID, *auxilium*, in ancient customs, a subsidy paid by vassals to their lord on certain occasions.

Such were the aid of relief, paid upon the death of the Lord Mesne to his heir; the *aid cheval*, or capital

pital aid, due to the chief lord on ſeveral occaſions, as, to make his eldeſt ſon a knight, to make up a portion for marrying his daughter, *&c.*

Royal AID, an appellation ſometimes given to the land-tax.

AIDS, in the French cuſtoms, certain duties paid on all goods exported or imported into that kingdom.

Court of AIDS, in France, a ſovereign court eſtabliſhed in ſeveral cities, which has cognizance of all cauſes relating to the taxes, gabels, and aids.

AIDS, in the menage, are the ſame with what ſome writers call *cheriſhings*, and uſed to avoid the neceſſity of corrections.

The inner heel, inner leg, inner rein, *&c.* are called *inner aids*; as the outer heel, outer leg, outer rein, *&c.* are called *outer aids.*

AIDS *of aſſizers of wood.* See ASSIZER.

AIDINELLI, or AIDIN-ILI, the modern or Turkiſh name of Natolia, or Leſſer Aſia. See NATOLIA.

AIELO, or AIELLO, a ſmall town of the kingdom of Naples, in the Farther Abruzzo, with the title of Dutchy.

AIGHENDALE,, the name of a liquid meaſure uſed in Lancaſhire, containing ſeven quarts.

AIGITHALUS, in ornithology, an obſolete name of the parus or titmouſe. See PARUS.

AIGLE, in geography, the name of a town of France, in the Higher Normandy; alſo of a promontory in Provence, lying ſouthward of the city of Ciotad; and of a town and diſtrict of Switzerland, in the canton of Bern.

AIGRE, a river of France, otherwiſe called *Egre.* See the article EGRE.

AIGLETTE, in heraldry. EAGLET.

AIGRETTA, in ornithology, an obſolete name of the ardea alba. See ARDEA.

AIGUE-*marine.* See AQUA *marina.*

AIGUILLON, or EGUILLON, a ſmall town of France, in the province of Guienne, ſituated at the conflux of the rivers Garonne and Lot.

AIGUISCE, AIGUISSE, or EGUISCE, in heraldry, denotes a croſs with its four ends ſharpened, but ſo as to terminate in obtuſe angles.

It differs from the croſs fitchee, in as much as the latter tapers by degrees to a point, and the former only at the ends.

AILE, or AIEL, in law, a writ which lies where a perſon's grandfather, or great-grandfather, being ſeiſed of lands, *&c.* in fee ſimple the day that he died, and a ſtranger abates or enters the ſame day, and diſpoſſeſſes the heir of his inheritance.

AILESBURY, the county town of Buckinghamſhire, ſituated near the Thames, about forty-four miles W. of London. It ſends two members to parliament, and gives the title of *earl* to the noble family of Bruce. W. long. 16. 55. N. lat. 51. 40.

AIMARGUES, a ſmall town of France, in the province of Languedoc, and dioceſe of Niſmes.

AIN, a river of France, which, after watering part of Franche Comte and Breſſe, falls into the Rhone, about four leagues above Lyons.

AIPIMIXIRA, in ichthyology, the American name of a fiſh called *pudano.*

AIR, a thin tranſparent fluid which encompaſſes the globe of the earth to a conſiderable height. For the weight, preſſure, elaſticity, *&c.* of air, ſee PNEUMATICS.

AIR, in medicine, one of the ſix non-naturals, and as eſſential to the life of animals as food, or any of the ordinary evacuations.

AIR, in mythology, was adored by the heathens under the names of Jupiter and Juno; the former repreſenting the ſuperior and finer part of the atmoſphere, and the latter the inferior and groſſer part. The augurs alſo drew preſages from the clouds, thunder, lightning, *&c.*

AIR, in painting, *&c.* denotes the manner and very life of action; or it is that which expreſſes the diſpoſition of the agent.

It is ſometimes alſo uſed in a ſomewhat ſynonymous ſenſe with geſture or attitude.

AIR, in muſic, denotes the melody proper for ſongs, odes, and the like; being uſually quick and lively.

Sometimes it is uſed for the ſongs themſelves, called by the Romans *aera*, from which the modern term *air* is derived.

AIRS, in the menage, are the artificial motions of taught horſes, as the demivolt, curvet, capriole, *&c.* See DEMIVOLT, *&c.*

AIR-*bladder*, a veſicle in the bodies of moſt fiſhes, by which, being filled with air, they are enabled to ſink or raiſe themſelves in the water, by compreſſing or expanding the air contained in this bag, and thereby rendering their bodies at pleaſure ſpecifically heavier or lighter than water.

AIR-*gun*, a machine for exploding balls by means of condenſed air. See PNEUMATICS.

AIR-*pump*, a machine by which the air contained in a proper veſſel may be exhauſted, or drawn out. See PNEUMATICS.

AIR-*ſhafts*, among miners, are holes made to meet the adits, and ſupply them with freſh air. Theſe, when the adits are long, or exceeding thirty or forty fathom, become highly neceſſary, as well to give vent to the damps and noxious vapours, as to let in freſh air.

AIR-*threads.* See GOSSAMER.

AIR-*veſſels*, are ſpiral ducts in the leaves, *&c.* of plants, ſuppoſed to be analogous to the lungs of animals, in ſupplying the different parts of a plant with air.

AIRA, in botany, a genus of the triandria digynia claſs. There are 14 ſpecies of the aira, nine of which are natives of Britain. The Engliſh name is *hair-graſs.*

AIREBA, in ichthyology, a ſynonime of the raja paſtinaca. See PASTINACA,

AIRANI, in church-hiſtory, a branch of Arians, who, beſide the common dogma of that ſect, denied the conſubſtantiality of the Holy Ghoſt with the Father and Son.

AIRE, in geography, a ſea-port town in Scotland, ſituated in 4. 40. W. long. and 55. 30. N. lat. at the

the mouth of a river of the ſame name, which diſcharges itſelf into the frith of Clyde. Aire is the chief town of the county, and very ancient. About a mile north from the town, there is a lazar-houſe, commonly called *the King's chapel*, which King Robert de Bruce ſet apart for the maintenance of lepers.

AIRE, is alſo the name of two towns of France, the one ſituated in the province of Gaſcony, about ſixty-five miles S. of Bourdeaux; and the other in Artois, about thirty-five miles S. E. of Calais.

AIRESHIRE, a county of Scotland, the capital of which is the town of Aire. It lies eaſtward of the frith of Clyde.

AIRING, a term peculiarly uſed for the exerciſing horſes in the open air.

AIRON, a river of France in the Nivernois.

AIRONO, a town of Italy, in the dutchy of Milan.

AIROU, a river of France in the province of Normandy.

AIRY, or AERY, among ſportſmen, a term expreſſing the neſt of a hawk or eagle.

AIRY *triplicity*, among aſtrologers, denotes the three ſigns, gemini, libra, and aquarius.

AISE, in geography. See AISNE.

AISIAMENTA, in law, the ſame with eaſement. See EASEMENT.

AISNE, or AISE, a river of France which riſes on the frontiers of Lorrain, near Clermont, and falls into the Oyſe, a little below Soiſons.

AITOCZU, a conſiderable river of Leſſer Aſia, which, ariſing in the mountain Taurus, falls into the ſouth part of the Euxine ſea.

AJUGA, in botany, a genus of the didynamia gymnoſpermia claſs. There are four ſpecies of the ajuga, of which the reptans or bugle, and the pyramidalis or mountain bugle, are natives of Britain.

AJURU-*catinga*, in ornithology, the Indian name of a ſpecies of the pſittacus or parrot. See PSITTACUS.

AJURU-*curau*, in ornithology, the Indian name of two ſpecies of Braſilian parrots, beautifully variegated with blue, green, red, yellow, and black.

AJURU-*para*, another parrot reſembling the ajuru-catinga, but ſmaller.

AJUTAGE, or ADJUTAGE, a kind of tube fitted to the mouth of the veſſel through which the water of a fountain is to be played. To the different form and ſtructure of ajutages, is owing the great variety of fountains. See FOUNTAIN.

AIX, in geography, the name of ſeveral places, *viz.* of a large city of France, the capital of Provence; of a ſmall town of Savoy, about eight miles N. of Chamberry; of an iſland on the coaſt of Gaſcony, between that of Oleron and the main-land; and of a village of Champagne, ſituated in the generality of Chalons.

AIX-LA-CHAPELLE, otherwiſe called *Aach*, *Ach*, and *Aken*, an imperial city of Germany, in the dutchy of Juliers. It is large and populous; being much reſorted to by foreigners, as well as by the Germans, on account of its hot baths.

AIZOON, in botany, a genus of the icoſandria pentandria claſs. The cup is divided into five parts; the flowers conſiſts of one leaf; the capſule or ſeed-veſſel has five cells; and the flower-cup reſts on the top of the fruit. There are three ſpecies of the aizoon, *viz.* the canarienſe, the hiſpanicum, and the paniculatum, which laſt is a native of Africa. This plant reſembles the ſedum or houſe-leek.

AKISSAR, or AK-HISSAR, a town of Leſſer Aſia, ſituated upon the river Hermus.

AKOND, in the Perſian affairs, the chief judge in all caſes of contracts and other civil affairs. He is at the head of the lawyers, and has his deputies in all courts of the kingdom.

AKROCZIM, a town of Poland, with a caſtle of conſiderable ſtrength, ſituated in the Palatinate of Maſſovia.

AKSTADT, in geograghy. See the article AICHSTAT.

AL, an Arabic particle prefixed to words, and ſignifying much the ſame with the Engliſh particle *the:* Thus they ſay, alkermes, alkoran, *&c.* *i. e.* the kermes, the koran, *&c.*

AL, or ALD, a Saxon term frequently prefixed to the names of places, denoting their antiquity, as Aldborough, Aldgate, *&c.*

ALA, a Latin term properly ſignifying a wing; from a reſemblance to which ſeveral other things are called by the ſame name: Thus,

ALA, in botany, is uſed in different ſenſes; ſometimes it denotes the hollow between the ſtalk of a plant and the leaves; ſometimes it is applied to the two ſide-petals of the papilionaceous flowers; others uſe it for the ſlender membranaceous expanſions found in the ſtems of plants, thence denominated *alated ſtalks*.

ALA, in botany, an obſolete name of the helenium. See HELENIUM.

ALÆ, in anatomy, a term applied to the lobes of the liver, the cartilages of the noſtril, *&c.*

ALÆ, in the Roman art of war, were the two wings or extreme parts of the army drawn up in order of battle.

ALABA, in geography, the name of a kingdom of Africa, dependent on the empire of Abyſſinia, or Ethiopia, the capital of which is called by the ſame name.

ALABASTER, in natural hiſtory, a genus of foſſils reſembling marble, which are bright, brittle, and do not give fire with ſteel; they ferment with acids, and readily calcine with heat. There are three ſpecies of alabaſter; 1. The ſnow-white ſhining alabaſter, or lygdinum of the ancients, is found in Taurus in pieces large enough to make diſhes, or the like. It cuts very freely, and is capable of a fine poliſh. 2. The yellowiſh alabaſter, or phengites of Pliny, is found in Greece, and is of a ſoft looſe open texture, pretty heavy, and nearly of the colour of honey. This ſpecies has likewiſe been found in Germany, France, and in Derbyſhire in England. 3. Variegated, yellow, and reddiſh alabaſter. This ſpecies is the common alabaſter of the ancients, and is ſo ſoft that it may be cut with a knife: It is remarkably bright, and almoſt tranſparent; admits of a fine poliſh, and conſiſts of large angular ſparry concretions. It is not proof againſt water; it ferments violently with aqua-fortis, and burns

burns to a pale yellow. The colour of this ſpecies is a clear pale yellow reſembling amber, and variegated with undulated veins; ſome of which are pale red, others whitiſh, and others of a pale brown. It was formerly brought from Egypt, but is now to be met with in ſeveral parts of England. The alabaſters are frequently uſed by ſtatuaries for ſmall ſtatues, vaſes, and columns. After being calcined and mixed with water, they may be caſt in any mould like plaſter of Paris,

ALABASTER, in antiquity, a term not only uſed for a box of precious ointment; but alſo for a liquid meaſure, containing ten ounces of wine, or nine of oil.

ALABASTRA, in botany, a name uſed by the ancients for the calix or cup of flowers.

ALABASTRUM *dendroide*, a kind of laminated alabaſter, beautifully variegated with the figures of ſhrubs, trees, *&c.*

ALADINISTS, a ſect among the Mahometans, anſwering to free-thinkers among us.

ALADULIA, in geography, the moſt eaſterly diviſion of Leſſer Aſia, comprehending the ancient Cappadocia, and Armenia Minor.

ALAGON, a ſmall town of Spain, in the kingdom of Arragon, ſituated near the conflux of the river Xalon with the Ebro.

ALAIS, a conſiderable town of France, in the province of Languedoc, ſituated on the river Gardon, at the foot of the Cevennes.

ALAISEE, in heraldry, the ſame with humetty. See HUMETTY.

ALALCOMENIUS, in Grecian antiquity, the Bœotian name of the month called, by the Athenians, *Mæmaſterion.* See MÆMACTERION.

ALAMIRE, or A-LA-MI-RE, among muſicians, a note of the modern ſcale of muſic. See SCALE.

ALAMODALITY, in a general ſenſe, is the accommodating a perſon's behaviour, dreſs, and actions to the prevailing taſte of the country or times in which he lives.

ALAMODE, in commerce, a thin gloſſy black ſilk, chiefly uſed for womens hoods, and mens mourning ſcarfs.

ALAN, a ſmall river of England in the county of Cornwall, which falls into the Briſtol channel.

ALAN, is alſo a ſmall town of France, with a very fine caſtle, ſituated in the eaſtern diviſion of Gaſcony.

ALANA *gelba*, a name by which ſome writers call the yellowiſh tripoli. See TRIPOLI.

ALAND, or ALANDT, an iſland of the Baltic ſea, ſituated between 18. and 20. degrees of long. and between 59. and 61. degrees of lat.

ALANGUER, or ALENGUER, a town of Portugal, in the province of Eſtremadura, and about ſeven leagues from Liſbon.

ALANORARIUS, in our old cuſtoms, was a keeper of ſpaniels, ſetting-dogs, *&c.* for the uſe of ſportſmen. The word is derived from *alan*, a gothic term for a *grey-hound.*

ALANTEJO, in geography. See the article ALENTEJO.

ALAPOULI, in botany, an obſolete name of a ſpecies of the averrhoa. See AVERRHOA.

ALAQUECA, a ſtone brought from the E. Indies in ſmall gloſſy fragments, ſaid to ſtop hæmorrhages by external application.

ALARAF, among Mahometans, denotes the partition-wall which ſeparates heaven from hell.

ALARBES, or ALARABES, a name given to thoſe Arabians who live in tents, and diſtinguiſh themſelves by their dreſs from the others who live in towns.

ALARES, in Roman antiquity, an epithet given to the cavalry, on account of their being placed in the two wings of the army.

ALARES *muſculi.* See PTERYGOIDEUS.

ALARM, in the military art, denotes either the apprehenſion of being ſuddenly attacked, or the notice thereof, ſignified by firing a cannon, firelock, or the like.

False alarms are frequently made uſe of to harraſs the enemy, by keeping them conſtantly under arms. Sometimes alſo this method is taken to try the vigilance of the piquet-guard, and what might be expected from them in caſe of real danger.

ALARM-*bell*, that rung upon any ſudden emergency, as a fire, mutiny, or the like.

ALARM-*poſt*, or ALARM-*place*, the ground for drawing up each regiment in caſe of an alarm. This is otherwiſe called *the rendezvous.*

ALARM, in fencing, is the ſame with what is otherwiſe called an appel, or challenge. See CHALLENGE.

ALATAMAHA, a large river of N. America, which, riſing in the Apalachian mountains, runs ſouth-eaſt through the province of Georgia, and falls into the Atlantic ocean, below the town of Frederica.

ALATED *animals*, ſuch as are furniſhed with wings.

ALATED *leaves*, in botany, ſuch as are compoſed of ſeveral pinnated ones. See PINNATED.

ALATERNOIDES, in botany, a ſynonime of a ſpecies of the myrica. See MYRICA.

ALATERNUS, in botany, the trivial name of a ſpecies of the rhamnus. See RHAMNUS.

ALATRI, or ALATRO, a town of Italy in the Campagna di Roma, ſituated near the frontiers of Naples.

ALAVA, or ALABRO, in geography, a territory of Spain, being the ſouth-eaſt diviſion of the province of Biſcay.

ALAUDA, or LARK, in ornithology, a genus of birds of the order of paſſeres; the characters of which are theſe: The beak is cylindrical, ſubulated, ſtrait; and the two mandibles or chaps are of equal ſize. The tongue is bifid, and the hinder claw is ſtraight, and longer than the toe. There are nine ſpecies of the alauda. 1. Alauda-arvenſis, or common ſky-lark, which riſes in the air almoſt perpendicularly, and begins to ſing early in the ſpring, and generally leaves off about midſummer. See Plate III. fig. 2. 2. Alauda-pratenſis, or tit-lark, has the two outward feathers of the wing edged with white, and frequents the meadows. 3. The arborea, or wood-lark, is a native of Europe, and is diſtinguiſhed by an annular white fillet about the head. 4. The campeſtris, has one half of its chief feathers of the wings brown, except

except two in the middle which are white, and the throat and breaſt are yellowiſh. 5. The trivialis, whoſe chief feathers on the tail are brown, only half of the outermoſt is white, and the ſecond is white at the end, in the ſhape of a wedge; there is likewiſe a double whitiſh line on the wings. It is a native of Sweden, and perches on the tops of trees. 6. The criſtata; the chief tail-feathers are black, but the two outermoſt are edged with white, and the head is creſted. It is a native of Europe. 7. The ſpinoletta, the chief tail-feathers are black, only the outmoſt two are obliquely half white. It is a native of Italy. 8. The alpeſtris; the chief wing-feathers are half white, the throat yellow, and it has a black ſtreak under the eyes and on the breaſt. It is a native of N. America. 9. The magna, is yellow on the belly, with a crooked black ſtreak on the breaſt, and the three ſide-feathers of the tail white. It is a native of Africa and America.

ALAUDA *marina*, ſtint, or water-ouzel, in ornithology, an obſolete name of a ſpecies of the ſturnus. See STURNUS.

ALAUDA, in ichthyology, an obſolete name of a ſpecies of the blennius. See BLENNIUS.

ALAUSA, in ichthyology. See ALOSA.

ALAUTA, a conſiderable river of Turky in Europe, which, after watering the north-eaſt part of Tranſylvania, and part of Wallachia, falls into the Danube almoſt oppoſite to Nicopolis.

ALB, or ALBE, in the Romiſh church, a veſtment of white linen hanging down to their feet, and anſwering to the ſurplice of our clergy. In the ancient church, it was uſual, with thoſe newly baptized, to wear an alb, or white veſtment; and hence the Sunday after eaſter was called *dominica in albis*, on account of the albs worn by thoſe baptiſed on eaſter-day.

ALB is alſo the name of a Turkiſh coin, otherwiſe called *aſper*. See ASPER.

ALBA *firma*, or ALBUM, in our old cuſtoms, denoted rent paid in ſilver, and not in corn, which was called *black-mail*.

ALBA *terra*, one of the numerous names for the philoſopher's ſtone.

ALBAHURIM, *figura ſexdecim laterum*, a figure of great importance according to aſtrological phyſicians, who built their prognoſtics on it.

ALBANENSES, in church-hiſtory, the ſame with Albigenſes. See ALBIGENSES.

ALBANI, in Roman antiquity, a college of the *ſalii*, or prieſts of Mars, ſo called from mount Albanus the place of their reſidence. See SALII.

ALBANIA, a province of Turky in Europe, ſituated on the eaſt-ſide of the gulph of Venice.

ALBANO, a town of Italy, in the Campagna di Roma, about twelve miles ſouth-eaſt of Rome, 13. 0. E.long. 41. 35. N. lat.

ALBANS, or ST ALBANS, a town of Hertfordſhire, ſituated about 20 miles north-weſt of London. It returns two members to parliament, and gives the title of *duke* to the noble family of Beauclerc, 51. 40. N. lat.

ALBANUM, a term uſed by ſome chemiſts for ſalt of urine.

ALBANY, a town of N. America, in the province of New-York, ſituated on Hudſon's river, in 74. 0. W. long. and 43. 0. N. lat.

ALBARA, among phyſicians, a malignant itch, nearly allied to the leproſy.

ALBARAZIN, a town of Spain, in the kingdom of Arragon, ſituated upon the river Guadalavir, about one hundred and ten miles eaſt of Madrid.

ALBARDEOLA, in ornithology. See PLATALEA.

ALBARIUM *opus*, in Roman antiquity, a kind of plaſter made of mere lime, uſed for covering the ceilings of houſes.

ALBATI *equi*, an appellation given to ſuch horſes, in the games of the ancient circus, as wore white furniture, in conſtradiſtinction from the *veneti*, *praſini*, and *ruſſeti*. See VENETI, PRASINI, *&c.*

ALBAZIN, a town of Greater Tartary, with a ſtrong caſtle: It is ſituated upon the river Amur, or Yamour, in 54. 0. of N. lat. and belongs to the Muſcovites.

ALBE, a ſmall piece of money, current in Germany, worth only a French ſol and ſeven deniers.

ALBELLUS, in ornithology, the trivial name of a ſpecies of the mergus. See MERGUS.

ALBEMARLE, a town of France, in the province of Normandy, from whence the noble family of Keppel takes the title of earl, in 2. 0. E. long. 49. 45. N. lat.

ALBEMARLE is alſo the name of the moſt northerly diſtrict of N. Carolina. See CAROLINA.

ALBENGA, a ſea-port town of Italy ſituated on the Mediterranean, about fifteen miles north-eaſt of Oneglia.

ALBERTUS, a gold coin, worth about fourteen French livres: it was coined during the adminiſtration of Albertus archduke of Auſtria.

ALBESIA, in antiquity, a kind of ſhields otherwiſe called *decumana*. See DECUMANA.

ALBICILLA, in ornithology, the trivial name of a ſpecies of the falco. See FALCO.

ALBIGENSES, in church-hiſtory, a ſect of Chriſtians which appeared in the 12th and 13th centuries. They are ranked among the groſſeſt heretics, the Manicheans, by Roman Catholics; from which charge Proteſtants generally acquit them, though with ſome limitation. See MANICHEANS.

At the time of the Reformation, thoſe of the Albigenſes who remained embraced Calviniſm.

ALBIGENSES is alſo a name ſometimes, though improperly, uſed for a ſect more uſually known by that of *Waldenſes*. See WALDENSES.

ALBIGEOIS, a ſmall diſtrict of France in the higher Languedoc, containing the dioceſes of Albi and Caſtres.

ALBII, in church-hiſtory, the ſame with Albigenſes. See ALBIGENSES.

ALBINOS, the name by which the Portugueſe call the white Moors, who are looked upon by the negroes as monſters. They are the iſſue of a white man and black woman, and at a diſtance might be taken for Europeans; but, when you come near them, their

white colour appears like that of perſons affected with with a leproſy.

ALBION, the ancient name of Britain. See BRITAIN.

New ALBION, a name given by Sir Francis Drake to California. See CALIFORNIA.

ALBLASSERWAERT, a diſtrict of South Holland, lying eaſtward of Dort, between the rivers Meuſe and Leck.

ALBOGALERUS, in Roman antiquity, a white cap worn by the *flamen dialis*, on the top of which was an ornament of olive branches.

ALBONA, ALBONO, or ALBOGNA, a river of Italy in the dutchy of Milan, which waters the Novareſe and diſtrict of Laumello.

ALBORAK, amongſt the Mahometan writers, the beaſt on which Mahomet rode, in his journeys to heaven.

ALBORAN, a ſmall iſland of Africa, lying on the coaſt of the kingdom of Fez.

ALBOURG, or ALBURG, a ſea-port town of N. Jutland, in the kingdom of Denmark.

ALBRET, or ALBRIT, a ſmall town of France, in the province of Gaſcony, about thirty-five miles S. of Bourdeaux.

ALBUCA, in botany, a genus of the hexandria monogynia claſs. There are only two ſpecies of this plant, *viz.* the major, with lanceolated leaves; and minor, with ſubulated leaves; both natives of the Cape of Good Hope.

ALBUCUS, in botany, an obſolete name of a ſpecies of aſphodelus.

ALBUGINEA *tunica*, in anatomy, the third or innermoſt coat or covering of the teſtes; it is likewiſe the name given to one of the coats of the eye. See ANATOMY, Part VI.

ALBUGINEUS, in anatomy, a term ſometimes applied to the aqueous humour of the eye.

ALBUGO, in medicine, a diſtemper occaſioned by a white opaque ſpot growing on the *cornea* of the eye, and obſtructing viſion.

ALBULA, in ichthyology, the trivial name of a ſpecies of the ſalmo. See SALMO.

ALBULA *indica*, in ichthyology, an obſolete name of the ſalmo bimaculatus. See SALMO.

ALBUM, in antiquity, a kind of table, or regiſter, wherein the names of certain magiſtrates, public tranſactions, *&c.* were entered. Of theſe there were various ſorts; as the *album ſenatorum*, *album judicum*, *album prætoris*, &c.

ALBUM. See ALBUMEN, CERUSS.

ALBUM *græcum*, among phyſicians, the white dung of dogs, formerly preſcribed for inflammations of the throat, *&c.* but now juſtly deſpiſed.

ALBUM *nigrum*, a term for mice-dung.

ALBUM *oculi*, the white of the eye. See ALBUGINEA, ADNATA.

ALBUMEN, among phyſicians, the white of an egg. See EGG.

ALBUQUERQUE, a city of Spain, in the kingdom of Leon and province of Eſtremadura, ſituated on the frontiers of Portugal, 7. 0. W. long. 30. 0. N. lat.

ALBURN, the Engliſh name of a compound colour, being a mixture of white and red, or reddiſh brown.

ALBURNUM, that part of the wood which is next the bark of trees.

ALBURNUS, in ichthyology, the trivial name of a ſpecies of the Cyprinus. See CYPRINUS.

ALBURNUS *lacuſtris*, an obſolete name of the cyprinus ballerus. See CYPRINUS.

ALBUS *piſcis*, an obſolete name of the cyprinus griſlagine. See CYPRINUS.

ALBY, or ALBI, a city of France in the province of Languedoc, ſituated in 0. 40. E. long. and 43. 50. N. lat.

ALCA, in ornithology, a genus of the order of anſeres. The beak of this genus is without teeth, ſhort, convex, compreſſed, and frequently furrowed tranſverſely; the inferior mandible is gibbous near the baſe; the feet have generally three toes. The ſpecies of the alca are ſix. 1. The tordo, or razor-bill, with four furrows on the bill, and a white line on each ſide running from the bill to the eyes. Great numbers of them hatch together in the caverns of rocks, and lay but one egg at a time. 2. The impennis, or northern penguin, with a compreſſed bill furrowed on each ſide, and an oval ſpot on each ſide of the eyes. 3. The arctica, or puffin, with a compreſſed bill and four furrows; the orbit of the eyes and temples are white. 4. The lomvia, or ſea-hen, with a ſmooth oblong bill, and the upper mandible yellow on the edges. 5. The grylle, or Greenland dove, with a ſmooth ſubulated bill, and a large white ſpot on the belly and wings; the feet are red. 6. The alle, or black and white diver, with a ſmooth conical bill, a white ſtreak on the belly and wings, and black feet. All the ſpecies of this genus frequent the northern ſhores of Europe.

ALCACER *de Sal*, or ALCAREZ, a town of Portugal in the province of Eſtremadura, about forty-five miles ſouth-eaſt of Liſbon; 9. 0. W. long. 38. 30. N. lat.

ALCAICS, in ancient poetry, a denomination given to ſeveral kinds of verſe, from the inventor Alcæus.

ALCAID, ALCAYDE, or ALCALDE, in the polity of the Moors, Spaniards, and Portugueſe, a magiſtrate, or officer of juſtice, anſwering nearly to the French provoſt, and the Britiſh juſtice of peace.—The alcaid among the Moors is veſted with ſupreme juriſdiction, both in civil and criminal caſes.

ALCALA *de Guadiara*, a town of Spain in the province of Andaluſia, about ſix miles S. of Seville.

ALCALA *de Henares*, a town of Spain, in the province of New Caſtile, about ſixteen miles E. of Madrid.

ALCALA *de Real*, a city of Spain, in the province of Andaluſia, about fifteen miles north-weſt of the city of Granada.

ALCALY. See ALKALI.

ALCANITZ, a ſmall town of Spain, in the kingdom of Arragon, ſituated on the river Guadaloupe.

ALCANNA, in commerce, a powder prepared from the leaves of the Egyptian privet, in which the people of Cairo drive a conſiderable trade. It is much uſed by the Turkiſh women, to give a golden colour to their

Plate X.

Fig. 1. ALCA or Razor bill

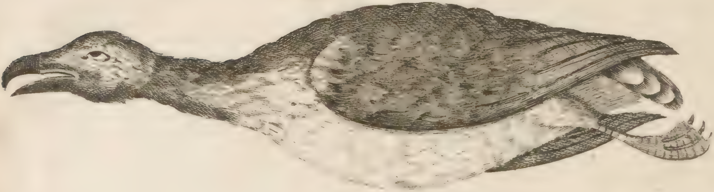


Fig. 2. ALCEDO or Kings Fisher

A. Bell Sculp.t

their nails and hair. In dying, it gives a yellow colour, when steeped with common water; and a red one, when infused in vinegar. There is also an oil extracted from the berries of alcanna, and used in medicine as a calmer.

ALCANNA. See ICHTHYOCOLLA.

ALCANTARA, a city of Spain, in the province of Estremadura, on the frontiers of Portugal; 7. 0. W. long. 39. 10. N. lat.

Knights of ALCANTARA, a military order of Spain, which took its name from the above-mentioned city. The knights of Alcantara make a very considerable figure in the history of the expeditions against the Moors.

ALCARAZ, a town of Spain, in the province of New-Castile, situated on the river Guadarema; 3. 0. W. long. 38. 3. N. lat.

ALCAZAR *de Sal*, a small town of Portugal, in the province of Estremadura, near the confines of that of Alantejo.

ALCE, or ALCES, in zoology, the trivial name of a species of the cervus, belonging to the order of mammalia pecora. See CERVUS.

ALCEA, or VERVAIN-MALLOW, in botany, a genus of the monodelphia polyandria class. There are only two species of this genus, *viz.* the rosea and ficifolia. This genus differs little from the common mallow, either in figure or medical virtues, excepting that the leaves of the alcea are more deeply divided.

ALCEA *vesicaria*, in botany, an obsolete name of a species of the ketmia. See KETMIA.

ALCEDO, or the KINGS-FISHER, in ornithology, a genus of the order of picæ. The alcedo has a long, strait, thick, triangular bill; with a fleshy, plain, short, flat tongue. There are seven species of the alcedo, *viz.* 1. The ispida, or common kings-fisher, with a short tail, blue above, and yellowish below. It haunts the shores of Europe and Asia. 2. The erithaca, with a short tail, a blue back, a yellow bill, a purple head and rump, and the throat and opposite part of the neck white. It is a native of Bengal. 3. The alcyon, with a short black tail, white belly, and ferruginous breast. It is a native of America. 4. The todus, with a short green tail, a blood-coloured throat, and a white belly. It is a native of America; and is the green sparrow, or green humming-bird of Edwards. 5. The smyrnensis, with a short green tail, ferruginous wings, and green back. It is a native of Africa and Asia. 6. The rudis, with a brown short tail variegated with white. It is a native of Persia and Egypt. 7. The dea, with two very long feathers in the tail, a blackish blue body, and greenish wings. It is a native of Surinam. All the species of this genus dive in the water, and catch fish with their long beaks.

ALCHEMILLA, or LADIES-MANTLE, a genus of the tetrandria monogynia class. The leaves of this genus are serrated. The cup is divided into eight segments; the flowers are apetalous, and collected in bunches upon the tops of the stalk; the seed-capsules generally contain two conic seeds in each. There are only three species of the alchemilla, *viz.* the vulgaris of the shops, which is esteemed a powerful vulnerary; the minor, or least ladies-mantle; and the alpina, or cinque-foil ladies-mantle; all of which are natives of Britain.

ALCHEMIST, a practitioner in alchemy. See ALCHEMY.

ALCHEMY, that branch of chemistry which had for its principal objects the transmutation of metals into gold; the panacea, or universal remedy; an alkahest, or universal menstruum; an universal ferment; and many other things equally ridiculous. See CHEMISTRY, *Introduction*.

ALCHEMY is also sometimes used as a synonymous term for chemistry in general.

ALCHIMILLA. See ALCHEMILLA.

ALCHIMY, ALCHYMY, and ALCHYMIST. See ALCHEMY, and ALCHEMIST.

ALCHITRAM, or ALCHITRAN, a term among alchemists for the oil of juniper, *&c.*

ALCIBIUM, or ALCIBIADUM, in botany, an obsolete term of a species of echium. See ECHIUM.

ALCMAER, a town of N. Holland, remarkable for the fine pastures in its neighbourhood, and the great quantities of butter and cheese made there.

ALCMANIAN, in ancient lyric poetry, a kind of verse consisting of two dactyles and two trochees; as,

Virgini|bus pue|risque| canto.

ALCOA *arbor*, the name of a tree in St Helena, said to emulate ebony.

ALCOBACO, a small town of Portugal, in the province of Estremadura: It is defended by a pretty strong castle; but what makes it most remarkable, is the abbey of St Bennet, which is the burying-place of most of the kings of Portugal.

ALCOHOL, or ALKOOL, in chemistry, spirit of wine highly rectified. It is also used for any highly rectified spirit.—Alcohol is extremely light and inflammable: It is a strong antiseptic, and therefore employed to preserve animal substances. For the other qualities of alcohol, see CHEMISTRY.

ALCOHOL is also used for any fine impalpable powder.

ALCOHOLIZATION, among chemists, the process of rectifying any spirit. It is also used for pulverization.

ALCOLA, a term among chemists for the tartar of urine.

ALCORAN, or ALKORAN, the name of a book held equally sacred among the Mahometans, as the Bible is among Christians.

The word *alkoran* properly signifies *reading*; a title given it by way of eminence, just as we call the Old and New Testaments *Scriptures*. See MAHOMETANISM.

ALCORAN, in a figurative sense, is an appellation given to any books full of impostures or impiety.

ALCORAN, among the Persians, is also used for a narrow kind of steeple, with two or three galleries, where the

the priests, called Moravites, say prayers with a loud voice.

ALCORANISTS, among the Mahometans, an appellation given to those who adhere closely to the alcoran as the ultimate rule of faith: Such are the Persians, in contradistinction from the Turks, Arabs, &c. who admit a multitude of traditions besides the alcoran.

ALCOST, an obsolete name of a species of tansey.

ALCOVE, among builders, a recess, or part of a chamber separated by an estrade, or partition of columns, and other corresponding ornaments, in which is placed a bed of state, and sometimes seats to entertain company.

These alcoves are frequent in Spain, and the bed raised two or three ascents, with a rail at the foot.

ALCOYTIN, a small town of Portugal, in the province of Algarva, defended by one of the strongest castles in that kingdom.

ALCYON, the trivial name of a species of alcedo. See ALCEDO.

ALCYONIUM, in obsolete name of a submarine plant. It is also used for a kind of coral, or astroites, frequently found fossile in England.

ALDABARAM, in anatomy. See SESAMOIDEA.

ALDARU, in botany, an obsolete name of a species of pistachia. See PISTACHIA.

ALDBOROUGH, a sea-port town of Suffolk, which sends two members to parliament; 1. 40. E. long. 52. 20. N. lat.

ALDBOROUGH, is also a market-town of Yorkshire, about fifteen miles north-west of the city of York.

ALDEA, a town of Portugal, in the province of Estremadura, about ten miles S. of Lisbon.

ALDEBAC, the Arabian term for bird-lime.

ALDEBARAN, in astronomy, a star of the first magnitude, called, in English, the bull's eye, as making the eye of the constellation Taurus.

ALDEGO, a river of Italy, in the territories of Venice, which loses itself in the Adige.

ALDENAER, a small town of Germany in the electorate of Cologn, situated on the river Aar.

ALDENBURG. See ALTENBURG.

ALDER-*tree*, in botany. See BETULA.

ALDERMAN, in the British policy, a magistrate subordinate to the lord-mayor of a city or town-corporate.

The number of these magistrates is not limited, but is more or less according to the magnitude of the place. In London they are twenty-six; each having one of the wards of the city committed to his care. This office is for life; so that when one of them dies, or resigns, a ward-mote is called, who return two persons, one of whom the lord-mayor and aldermen chuse to supply the vacancy. By the charter of the city of London, all the aldermen who have been lord-mayors, together with the three eldest ones not arrived at that dignity, are justices of the peace.

ALDERMAN, among our Saxon ancestors, was a degree of nobility answering to earl or count at present.

ALDERMAN was also used, in the time of King Edgar, for a judge or justice; in which sense Alwin is called *aldermannus totius Angliæ*.

ALDERNEY, or AURIGNI, an island on the coast of Normandy, subject to the crown of Great Britain.

ALDII, an appellation given to those servants who attended their masters to the wars.

ALDROVANDA, in botany, a genus of the pentandria pentagynia class; of which there is but one species. The calix is divided into five parts; the petals are five; and the capsule has five valves, with ten seeds. It is a native of Italy and the Indies.

ALE, a fermented liquor, obtained from an infusion of malt; and differing only from beer in having a less proportion of hops. See BREWING.

Ale is thought to be the same kind of liquor with the cerevisia, zythum, and curmi of the ancients.

Medicated ALES, those wherein medicinal herbs have been infused, or put to ferment: Such are the cerevisia cephalica, cerevisia epileptica, &c.

ALE-*berry*, the popular name for ale that is boiled with bread and mace, sweetened, strained, and drunk hot.

ALE-*connor*, an officer in London who inspects the measures of public houses. They are four in number, and chosen by the common-hall of the city.

ALE-*silver*, a tax paid yearly to the lord-mayor, by all who sell ale within the city.

ALE-*measure*. See MEASURE.

ALEA, in Roman antiquity, denotes in general all manner of games of chance; but, in a more restricted sense, was used for a particular game played with dice and tables, not unlike our backgammon. See BACKGAMMON.

ALEATORIUM, a place in the ancient gymnasia, where they played at the aleæ.

ALEC, in ichthyology, an obsolete name a species of sparus. See SPARUS.

ALECOST. See ALCAST.

ALECTORIA, a stone said to be formed in the gall-bladders of old cocks, to which the ancients ascribed many fabulous virtues.

ALECTORICARDITES, the name of a stone resembling a pullet's head.

ALECTORIUS *lapis*. See ALECTORIA.

ALECTOROMANTIA, in Grecian antiquity, a species of divination performed by means of a cock, in the following manner: A circle being described on the ground, and divided into twenty-four equal portions, in each of these spaces was written one of the letters of the alphabet, and on each of the letters was laid a grain of wheat; after which a cock being turned loose in the circle, particular notice was taken of the grains picked up by the cock, because the letters under them, being formed into a word, made the answer desired.

ALEAGAR, or ALEGER, the name of a kind of vinegar made of ale instead of wine.

ALEGRETTE, a town of Portugal, in the province of Alantejo, situated on the river Caya; 7. 50. W. long. 39. 0. N. lat.

ALEIPHA, among ancient physicians, the name of animal or vegetable oils, when used as unguents.

ALEMBIC, in chemistry. See CHEMISTRY.

ALEMBROTH, an obsolete name of a kind of fixed alkaline salt.

ALENGNER,

ALENGNER, a town of Portugal, in the province of Eſtremadura, about twenty-ſeven miles N. E. of Liſbon.

ALENON *ſalt*, an obſolete name of the oil of almonds.

ALENTEJO, a province of Portugal, lying ſouthward of Tagus.

ALENZON, a ſtrong city of Normandy, ſituated under the ſame meridian with London, in 48. 32. N. lat. It is the capital of the dutchy of the ſame name.

ALEORE, among ancient phyſicians, denoted the intervals of eaſe that alternately ſucceed acute pains.

ALEPPO, a large city of Aſiatic Turky, ſituated in E. long. 37. 4. and N. lat. 36. 30.

It is an inland town, lying almoſt in the middle between the river Euphrates and the Levant ſea. The Chriſtians, who are allowed the free exerciſe of their religion, have their houſes and churches in the ſuburbs.

The beglerbeg of Aleppo commands the whole extent of country, between the Levant-ſea and the Euphrates.

ALERION, or ALLERION, in heraldry. See ALLERION.

ALESSANO, a town of the kingdom of Naples, ſituated about twelves miles weſt of the city Otranto.

ALESSIO, a town of European Turky, in the province of Albania, ſituated near the mouth of the river Drimo.

ALET, or ALETH, a city of France, ſituated in the Upper Languedoc, at the foot of the Pyrennees, about thirty-two miles ſouth-weſt of Narbonne, 2. 0. E. long. 43. 10. N. lat.

ALETRIS, in botany, a genus of the hexandria monogynia claſs. The corolla is tunnel-ſhaped, the ſtamina are inſerted into the baſe of the petals; and the capſule conſiſts of three cells. There are only three ſpecies of the aletris, *viz.* the farinoſa, a native of America; the capenſis, a native of the Cape of Good Hope; and the fragrans, a native of Africa. The two firſt are perennial plants, and the laſt is a fruit-bearing ſhrub. Theſe are all ranked among the aloes of different authors. See ALOE.

ALEUROMANCY, a ſpecies of divination performed by means of meal or flour.

ALEXANDERS, in botany. See SMYRNIUM.

ALEXANDRETTA, in geography, the ſame with Scanderoon. See the article SCANDEROON.

ALEXANDRIA, a ſea-port town of Egypt, ſituated in 31. 15. E. long. and 30. 40. N. lat. about fourteen miles weſtward of the moſt weſterly branch of the river Nile.

ALEXANDRIA is alſo the name of a city of Italy, ſituated on the river Tanaro, about forty miles N. W. of Genoa, 8. 52. E. long. 44. 45. N. lat.

ALEXANDRIAN, or ALEXANDRIN, in poetry, a kind of verſe, conſiſting of twelve, or of twelve and thirteen ſyllables alternately; ſo called from a poem on the life of Alexander, written in this kind of verſe by ſome French poet.

Alexandrines are peculiar to modern poetry, and ſeem well adapted to epic poems. They are ſometimes uſed by moſt nations of Europe, but chiefly by the French, whoſe tragedies are generally compoſed of Alexandrines.

ALEXANDRINUM, the name of a plaſter deſcribed by Celſus.

ALEXICACUS. See ALEXETERIAL.

ALEXICACUS was alſo a name under which the fiſhermen uſed to invoke Neptune, to preſerve their nets from being torn to pieces by the ſword-fiſh.

ALEXIPHARMICS, among phyſicians, properly ſignify medicines which correct or expel poiſon.

ALEXITERIAL. See the laſt article.

ALFAQUES, among the Moors, the name generally uſed for their clergy, or thoſe who teach the Mahometan religion, in oppoſition to the Morabites, who anſwer to monks among Chriſtians.

ALFELD, a town of Germany, in the biſhoprick of Hildeſheim, and circle of Lower Saxony, ſituated about ten miles S. of Hildeſheim, in 9. 50. E. long. and 52. 0. N. lat.

ALFET, in our old cuſtoms, denotes a caldron full of boiling water, wherein an accuſed perſon, by way of trial or purgation, plunged his arm up to the elbow.

ALGA, in botany, the trivial name of the lichen, fucus, and ſeveral other plants of the cryptogamia claſs.

ALGAROT, in chemiſtry, an Arabic term for an emetic powder, prepared from regulus of antimony, diſſolved in acids, and ſeparated by repeated lotions in warm water.

ALGARVA, the moſt ſoutherly province of the kingdom of Portugal.

A L G E B R A.

ALGEBRA is a general method of computation by certain ſigns and ſymbols, which have been contrived for this purpoſe, and found convenient. It is called an UNIVERSAL ARITHMETIC, and proceeds by operations and rules ſimilar to thoſe in common arithmetic, founded upon the ſame principles. But as a number of ſymbols are admitted into this ſcience, being neceſſary for giving it that extent and generality which is its greateſt excellence, the import of thoſe ſymbols muſt be clearly ſtated.

In geometry, lines are repreſented by a line, triangles by a triangle, and other figures by a figure of the ſame kind: But, in algebra, quantities are repreſented by the ſame letters of the alphabet; and various ſigns have

been

been imagined for representing their affections, relations, and dependencies.

The relation of equality is expressed by the sign $=$; thus, to express that the quantity represented by a is equal to that which is represented by b, we write $a = b$. But if we would express that a is greater than b, we write $a \sqsupset b$; and if we would express algebraically that a is less than b, we write $a \sqsubset b$.

QUANTITY is what is made up of parts, or is capable of being greater or less. It is increased by *addition*, and diminished by *subtraction*; which are therefore the two primary operations that relate to quantity. Hence it is, that any quantity may be supposed to enter into algebraic computations two different ways, which have contrary effects; either as an *increment*, or as a *decrement*; that is, as a quantity to be added, or as a quantity to be subtracted. The sign $+$ (*plus*) is the mark of *addition*, and the sign $-$ (*minus*) of *subtraction*. Thus the quantity being represented by a, $+a$ imports that a is to be added, or represents an increment; but, $-a$ imports that a is to be subtracted, and represents a decrement. When several such quantities are joined, the signs serve to shew which are to be added and which are to be subtracted. Thus $+a+b$ denotes the quantity that arises when a and b are both considered as increments, and therefore expresses the sum of a and b. But $+a-b$ denotes the quantity that arises, when from the quantity a the quantity b is subtracted; and expresses the excess of a above b. When a is greater than b, then $a-b$ is itself an increment; when $a=b$, then $a-b=0$; and when a is less than b, then $a-b$ is itself a decrement.

As addition and subtraction are opposite, or an increment is opposite to a decrement, there is an analogous opposition between the affections of quantities that are considered in the mathematical sciences; as, between excess and defect; between the value of effects or money due to a man, and money due by him. When two quantities, equal in respect of magnitude, but of those opposite kinds, are joined together, and conceived to take place in the same subject, they destroy each other's effect, and their amount is *nothing*. Thus, 100 *l.* due to a man and 100 *l.* due by him balance each other, and in estimating his stock may be both neglected. When two unequal quantities of those opposite qualities are joined in the same subject, the greater prevails by their difference. And, when a greater quantity is taken from a lesser of the same kind, the remainder becomes of the opposite kind.

A quantity that is to be added is likewise called a *positive* quantity; and a quantity to be subtracted is said to be *negative*: They are equally real, but opposite to each other, so as to take away each other's effect, in any operation, when they are equal as to quantity. Thus, $3-3=0$, and $a-a=0$. But though $+a$ and $-a$ are equal as to quantity, we do not suppose in algebra that $+a=-a$; because, to infer equality in this science, they must not only be equal as to quantity, but of the same quality, that in every operation the one may have the same effect as the other. A decrement may be equal to an increment, but it has in all operations a contrary effect; a motion downwards may be equal to a motion upwards; and the depression of a star below the horison may be equal to the elevation of a star above it: But those positions are opposite, and the distance of the stars is greater than if one of them was at the horizon, so as to have no elevation above it, or depression below it. It is on account of this contrariety, that a negative quantity is said to be less than nothing, because it is opposite to the positive, and diminishes it when joined to it; whereas the addition of 0 has no effect. But a negative is to be considered no less as a real quantity than the positive. Quantities that have no sign prefixed to them are understood to be positive.

The number prefixed to a letter is called the numeral *coefficient*, and shews how often the quantity represented by the letter is to be taken. Thus $2a$ imports that the quantity represented by a is to be taken twice; $3a$ that it is to be taken thrice; and so on. When no number is prefixed, *unit* is understood to be the coefficient. Thus 1 is the coefficient of a or of b.

Quantities are said to be *like* or *similar*, that are represented by the same letter or letters equally repeated. Thus $+3a$ and $-5a$ are like; but a and b, or a and aa are unlike.

A quantity is said to consist of as many terms as there are parts joined by the signs $+$ or $-$; thus $a+b$ consists of two terms, and is called a *binomial*; $a+b+c$ consists of three terms, and is called a *trinomial*. These are called *compound* quantities: A *simple* quantity consists of one term only, as $+a$, or $+ab$, or $+abc$.

CHAP. I. *Of* ADDITION.

CASE I. *To add quantities that are like, and have like signs.*

RULE. Add together the coefficients, to their sum prefix the common sign, and subjoin the common letter or letters.

EXAMPLE.			
	To $+5a$	to $-6b$	to $a+b$
	Add $+4a$	add $-2b$	add $3a+5b$
	Sum $+9a$	Sum $-8b$	Sum $4a+6b$

CASE II. *To add quantities that are like, but have unlike signs.*

RULE. Subtract the lesser coefficient from the greater, prefix the sign of the greater to the remainder, and subjoin the common letter or letters.

EXAMP.		
	To $-4a$	$+5b-6c$
	Add $+7a$	$-3b+8c$
	Sum $+3a$	$2b+2c$

This rule is easily deduced from the nature of positive and negative quantities.

If there are more than two quantities to be added together, first add the positive together into one sum, and then the negative (by *Case* I.); then add these two sums together (by *Case* II.)

CASE

Case III. *To add quantities that are unlike.*

Rule. Set them all down one after another, with their signs and coefficients prefixed.

Example.	To $+2a$	$+3a$
	Add $+3b$	$-4x$
	Sum $2a+3b$	$3a-4x$

Chap. II. Of Subtraction.

General Rule. "Change the signs of the quantity to be subtracted into their contrary signs, and then add it so changed to the quantity from which it was to be subtracted, (by the rules of the last chapter): the sum arising by this addition is the remainder." For, to subtract any quantity, either positive or negative, is the same as to add the opposite kind.

Examp.	From $+5a$	$8a-7b$
	Subtract $+3a$	$3a+4b$
	Remaind. $5a-3a$, or $2a$	$5a-11b$

It is evident, that to subtract or take away a decrement is the same as adding an equal increment. If we take away $-b$ from $a-b$, there remains a; and if we add $+b$ to $a-b$, the sum is likewise a. In general, the subtraction of a negative quantity is equivalent to adding its positive value.

Chap. III. *Of* Multiplication.

In Mutiplication, the general rule for the signs is, That *when the signs of the factors are like,* (i. e. both $+$; or both $-$), *the sign of the product is* $+$; but *when the signs of the factors are unlike, the sign of the product is* $-$.

Case I. When any positive quantity, $+a$, is multiplied by any positive number, $+n$, the mean-is, That $+a$ is to be taken as many times as there are units in n; and the product is evidently na.

Case II. When $-$ a is multiplied by n, then $-a$ is to be taken as often as there are units in n, and the product must be $-na$.

Case III. Multiplication by a positive number implies a repeated addition: But multiplication by a negative implies a repeated subtraction. And when $+a$ is to be multiplied by $-n$, the meaning is, That $+a$ is to be subtracted as often as there are units in n: Therefore the product is negative, being $-na$.

Case IV. When $-a$ is to be multiplied by $-n$, then $-a$ is to be subtracted as often as there are units in n; but (by chap. II.) to subtract $-a$ is equivalent to adding $+a$, consequently the product is $+na$.

The IId and IVth Cases may be illustrated in the following manner.

By the definitions, $+a-a=0$; therefore if we multiply $+a-a$ by n, the product must vanish, or be 0, because the factor $a-a$ is 0. The first term of the product is $+na$ (by Case I.) Therefore the second term of the product must be $-na$, which destroys $+na$; so that the whole product must be $+na-na=0$. Therefore $-a$ multiplied by $+n$ gives $-na$.

In like manner, if we multiply $+a-a$ by $-n$, the first term of the product being $-na$, the latter term of the product must be $+na$; because the two together must destroy each other, or their amount be 0, since one of the factors (viz. $a-a$) is 0. Therefore $-a$ multiplied by $-n$, must give $+na$.

In this general doctrine, the multiplicator is always considered as a number. A quantity of any kind may be multiplied by a number.

If the quantities to be multiplied are *simple* quantities, "find the sign of the product by the last rule; after it place the product of the coefficients, and then set down all the letters after one another as in one word."

Examp.	Mult. $+a$	$-2a$	$6x$
	By $+b$	$+4b$	$-5a$
	Prod. $+ab$	$-8ab$	$-30ax$
	Mult. $-8x$	$+3ab$	
	By $-4a$	$-5ac$	
	Prod. $+32ax$	$-15aabc$	

To multiply *compound* quantities, you must "multiply every part of the multiplicand by all the parts of the multiplier, taken one after another, and then collect all the products into one sum: That sum shall be the product required."

Examp.	Mult. $a+b$	$2a-3b$
	By $a+b$	$4a+5b$
	Prod. $\begin{cases} aa+ab \\ \quad\ +ab+bb \end{cases}$	$\begin{cases} 8aa-12ab \\ \quad\ +10ab-15bb \end{cases}$
	Sum $aa+2ab+bb$	$8aa-2ab-15bb$

Mult. $aa+ab+bb$
By $a-b$

Prod. $\begin{cases} aaa+aab+abb \\ \quad\ -aab-abb-bbb \end{cases}$

Sum $aaa\,..\,0\,...\,0\,..-bbb$

Products that arise from the multiplication of two, three, or more quantities, as abc, are said to be of two, three, or more *dimensions*; and those quantities are called *factors* or *roots*.

If all the factors are equal, then these products are called *powers*; as aa, or aaa, are powers of a. Powers are expressed sometimes by placing above the

root,

root, to the right hand, a figure expreſſing the number of factors that produce them. Thus,

$$\left.\begin{array}{l} a \\ a\,a \\ a\,a\,a \\ a\,a\,a\,a \\ a\,a\,a\,a\,a \end{array}\right\} \text{is called the} \left\{\begin{array}{l} \text{1ſt} \\ \text{2d} \\ \text{3d} \\ \text{4th} \\ \text{5th} \end{array}\right\} \begin{array}{l} \text{Power of the} \\ \text{root } a, \text{ and} \\ \text{is ſhortly} \\ \text{expreſſed} \\ \text{thus,} \end{array} \left\{\begin{array}{l} a \\ a^2 \\ a^3 \\ a^4 \\ a^5 \end{array}\right.$$

Theſe figures which expreſs the number of factors that produce powers, are called their *indices* or *exponents*; thus 2 is the index of a^2. And *powers of the ſame root are multiplied by adding their exponents.* Thus $a^2 \times a^3 = a^5$. $a^4 \times a^3 = a^7$. $a^3 \times a = a^4$.

Sometimes it is uſeful not actually to multiply compound quantities, but to ſet them down with the ſign of multiplication (×) between them, drawing a line over each of the compound factors. Thus $\overline{a+b} \times \overline{a-b}$ expreſſes the product of $a + b$, multiplied by $a - b$.

Chap. IV. *Of* Division.

The ſame rule for the ſigns is to be obſerved in diviſion as in multiplication; that is, "If the ſigns of the "dividend and diviſor are like, the ſign of the quotient "muſt be +; if they are unlike, the ſign of the quo- "tient muſt be —." This will be eaſily deduced from the rule in multiplication, if you conſider, that the quotient muſt be ſuch a quantity as, multiplied by the diviſor, ſhall give the dividend.

The general rule in diviſion is, "to place the dividend "above a ſmall line, and the diviſor under it, expun- "ging any letters that may be found in all the quanti- "ties of the dividend and diviſor, and dividing the co- "efficients of all the terms by any common meaſure." Thus, when you divide $10\,a\,b + 15\,a\,c$ by $20\,a\,d$, expunging a out of all the terms, and dividing all the coefficients by 5, the quotient is $\dfrac{2\,b + 3\,c}{4\,d}$; and

$$2\,b)\ a\,b + b\,b\ \left(\frac{a+b}{2}\right.$$

"Powers of the ſame root are divided by ſubtracting "their exponents, as they are multiplied by adding "them." Thus, if you divide a^5 by a^2, the quotient is a^{5-2} or a^3. And b^6 divided by b^4 gives b^{6-4} or b^2; and $a^7\,b^5$ divided by $a^2\,b^3$ gives $a^5\,b^2$ for the quotient.

"If the quantity to be divided is compound, then "you muſt range its parts according to the dimenſions of "ſome one of its letters, as in the following example." In the dividend $a^2 + 2\,a\,b + b^2$, they are ranged according to the dimenſions of a, the quantity a^2, where a is of two dimenſions, being placed firſt, $2\,a\,b$, where it is of one dimenſion, next, and b^2, where a is not at all, being placed laſt. "The diviſor muſt be ranged "according to the dimenſions of the ſame letters; then "you are to divide the firſt term of the dividend by the "firſt term of the diviſor, and to ſet down the quotient, "which, in this example, is a; then multiply this quo- "tient by the whole diviſor, and ſubtract the product "from the dividend, and the remainder ſhall give a new "dividend, which, in this example, is $a\,b + b^2$."

$$\begin{array}{l} a+b)\ a^2 + 2\,a\,b + b^2\ (a+b \\ \qquad\quad a^2 + a\,b \\ \hline \qquad\qquad\quad a\,b + b^2 \\ \qquad\qquad\quad a\,b + b^2 \\ \hline \qquad\qquad\quad 0. \quad 0. \end{array}$$

"Divide the firſt term of this new dividend by the "firſt term of the diviſor, and ſet down the quotient, "(which in this example is b), with its proper ſign. "Then multiply the whole diviſor by this part of the "quotient, and ſubtract the product from the new divi- "dend; and if there is no remainder, the diviſion is fi- "niſhed:" If there is a remainder, you are to proceed after the ſame manner, till no remainder is left; or till it appear that there will be always ſome remainder.

Some examples will illuſtrate this operation.

Examp. I.
$$\begin{array}{l} a+b)\ a^2 - b^2\ (a-b \\ \qquad\quad a^2 + a\,b \\ \hline \qquad\qquad - a\,b - b^2 \\ \qquad\qquad - a\,b - b^2 \\ \hline \qquad\qquad\quad 0. \quad 0. \end{array}$$

Examp. II.
$$\begin{array}{l} a-b)\ aaa - 3aab + 3abb - bbb\ (aa - 2ab + bb \\ \qquad\quad aaa - aab \\ \hline \qquad\qquad - 2aab + 3abb - bbb \\ \qquad\qquad - 2aab + 2abb \\ \hline \qquad\qquad\qquad\qquad abb - bbb \\ \qquad\qquad\qquad\qquad abb - bbb \\ \hline \qquad\qquad\qquad\qquad\quad 0. \quad 0. \end{array}$$

It often happens, that the operation may be continued without end, and then you have an *infinite ſeries* for the quotient; and *by comparing the firſt three or four terms you may find what law the terms obſerve: by which means, without any more diviſion, you may continue the quotient as far as you pleaſe.* Thus, in dividing 1 by $1 - a$, you find the quotient to be $1 + a + a\,a + a\,a\,a + a\,a\,a\,a +$ &c. which ſeries can be continued as far as you pleaſe, by adding the powers of a.

The operation is thus:

$$\begin{array}{l} 1-a)\ 1\ (1 + a + a\,a + a\,a\,a, \text{ \&c.} \\ \qquad\quad 1 - a \\ \hline \qquad\quad + a \\ \qquad\quad + a - a\,a \\ \hline \qquad\qquad\quad + a\,a \\ \qquad\qquad\quad + a\,a - a\,a\,a \\ \hline \qquad\qquad\qquad\quad + a\,a\,a \\ \qquad\qquad\qquad\quad + a\,a\,a - a\,a\,a\,a \\ \hline \qquad\qquad\qquad\qquad\qquad + a\,a\,a\,a, \text{ \&c.} \end{array}$$

Note, The ſign ÷ placed between any two quantities,

ties, expreſſes the quotient of the former divided by the latter. Thus, $\overline{a+b} \div \overline{a-x}$ is the quotient of $a+b$, divided by $a-x$.

CHAP. V. *Of* FRACTIONS.

IN the laſt chapter it was ſaid, that the quotient of any quantity a, divided by b, is expreſſed by placing a above a ſmall line, and b under it, thus, $\frac{a}{b}$. Theſe quotients are alſo called *fractions*; and the dividend, or quantity placed above the line, is called the *numerator* of the fraction, and the diviſor, or quantity placed under the line, is called the *denominator*.

"If the numerator of a fraction be equal to the denominator, then the fraction is equal to unity. Thus, $\frac{a}{a}$ and $\frac{b}{b}$ are equal to unit. If the numerator is greater than the denominator, then the fraction is greater than unit." In both theſe caſes, the fraction is called *improper*. But "if the numerator is leſs than the denominator, then the fraction is leſs than unit," and is called *proper*. Thus, $\frac{5}{3}$ is an improper fraction; but $\frac{3}{4}$ and $\frac{2}{3}$ are proper fractions. A mixt quantity is that whereof one part is an *integer*, and the other a *fraction*. As $3\frac{4}{5}$ and $5\frac{2}{3}$ and $a+\frac{a^2}{b}$.

PROBLEM I.

To reduce a MIXT *quantity to an* IMPROPER FRACTION.

RULE. Multiply the part that is an integer by the denominator of the fractional part; and to the product add the numerator; under their ſum place the former denominator.

Thus $2\frac{1}{5}$ reduced to an improper fraction gives $\frac{11}{5}$; $a+\frac{a^2}{b}=\frac{ab+a^2}{b}$; and $a-x+\frac{a^2-ax}{x}=\frac{a^2-x^2}{x}$.

PROBLEM II.

To reduce in IMPROPER *fraction to a* MIXT QUANTITY.

RULE. Divide the numerator of the fraction by the denominator, and the quotient ſhall give the integral part; the remainder ſet over the denominator ſhall be the fractional part.

$$\text{Thus } \frac{12}{5}=2\frac{2}{5};\ \frac{ab+a^2}{b}=a+\frac{a^2}{b}.$$

PROBLEM III.

To reduce fractions of different denominations to fractions of equal value that ſhall have the ſame denominator.

RULE. Multiply each numerator, ſeparately taken, into all the denominators but its own, and the products ſhall give the new numerators. Then multiply all the denominators into one another, and the product ſhall give the common denominator. Thus,

The fractions $\frac{a}{b}$, $\frac{b}{c}$, $\frac{c}{d}$, are reſpectively equal to theſe fractions $\frac{acd}{bcd}$, $\frac{bbd}{bcd}$, $\frac{ccb}{bcd}$, which have the ſame denominator bcd. And the fractions $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$, are reſpectively equal to theſe $\frac{40}{60}$, $\frac{45}{60}$, $\frac{48}{60}$.

PROBLEM IV.

To ADD *and* SUBTRACT *fractions.*

RULE. Reduce them to a common denominator, and add or ſubtract the numerators; the ſum or difference ſet over the common denominator, is the ſum or remainder required.

$\frac{a}{b}+\frac{c}{d}+\frac{d}{e}=\frac{ade+bce+d^2b}{bde}$; $\frac{a}{b}-\frac{c}{d}=\frac{ad-bc}{bd}$; $\frac{2}{3}+\frac{3}{4}=\frac{8+9}{12}=\frac{17}{12}=1\frac{5}{12}$: $\frac{3}{4}-\frac{2}{3}=\frac{9-8}{12}=\frac{1}{12}$; $\frac{4}{5}-\frac{3}{4}=\frac{16-15}{20}=\frac{1}{20}$; $\frac{x}{2}-\frac{x}{3}=\frac{3x-2x}{6}=\frac{x}{6}$.

PROBLEM V.

To MULTIPLY *fractions.*

RULE. Multiply their numerators one into another to obtain the numerator of the product; and their denominators multiplied into one another ſhall give the denominator of the product. Thus,

$$\frac{a}{b}\times\frac{c}{d}=\frac{ac}{bd};\ \frac{2}{3}\times\frac{4}{5}=\frac{8}{15}.$$

If a mixt quantity is to be multiplied, firſt reduce it to the form of a fraction (by Prob. I.) And, if an integer is to be multiplied by a fraction, you may reduce it to the form of a fraction by placing unit under it.

$$\text{EXAMP. } 5\frac{2}{3}\times\frac{3}{4}=\frac{17}{3}\times\frac{3}{4}=\frac{51}{12}.$$

PROBLEM VI.

To DIVIDE *Fractions.*

RULE. Multiply the numerator of the dividend by the denominator of the diviſor, their product ſhall give the numerator of the quotient. Then multiply the denominator of the dividend by the numerator of the diviſor, and their product ſhall give the denominator.

Thus, $\frac{4}{5}\Big)\frac{2}{3}\Big(\frac{10}{12}$; $\frac{3}{7}\Big)\frac{5}{8}\Big(\frac{35}{24}$; $\frac{c}{d}\Big)\frac{a}{b}\Big(\frac{ad}{cb}$.

To

PROBLEM VII.

To find the greateſt common meaſure of two numbers; that is, the greateſt number that can divide them both without a remainder.

RULE. Firſt divide the greater number by the leſſer, and if there is no remainder, the leſſer number is the greateſt common diviſor required. If there is a remainder, divide your laſt diviſor by it; and thus proceed continually, dividing the laſt diviſor by its remainder, till there is no remainder left, and then the laſt diviſor is the greateſt common meaſure required.

Thus, the greateſt common meaſure of 45 and 63 is 9; and the greateſt common meaſure of 256 and 48 is 16.

$$\begin{array}{l} 45)\ 63\ (1 \\ \quad\ \ 45 \\ \quad\ \ \overline{18)\ 45\ (2} \\ \qquad\quad\ 36 \\ \qquad\quad\ \overline{9)\ 18\ (2} \\ \qquad\qquad\ 18 \\ \qquad\qquad\ \overline{\ 0\ } \end{array} \qquad\qquad \begin{array}{l} 48)\ 256\ (5 \\ \qquad 240 \\ \qquad \overline{16)\ 48\ (3} \\ \qquad\qquad\ 48 \\ \qquad\qquad\ \overline{\ 0\ } \end{array}$$

Much after the ſame manner the greateſt common meaſure of algebraic quantities is diſcovered; only *the remainders that ariſe in the operation are to be divided by their ſimple diviſors*, and *the quantities are always to be ranged according to the dimenſions of the ſame letter*.

Thus to find the greateſt common meaſure of $a^2 - b^2$ and $a^2 - 2ab + b^2$;

$$\begin{array}{l} a^2 - b^2)\ a^2 - 2ab + b^2\ (1 \\ \qquad\qquad a^2 - b^2 \\ \qquad\qquad \overline{\quad - 2ab + 2b^2} \text{ Remainder,} \end{array}$$

which divided by $-2b$ is reduced to

$$\begin{array}{l} a - b)\ a^2 - b^2\ (a + b \\ \qquad\quad a^2 - b^2 \\ \qquad\quad \overline{\ 0 \quad 0\ } \end{array}$$

Therefore $a - b$ is the greateſt common meaſure required.

The ground of this operation is, That any quantity that meaſures the diviſor and the remainder (if there is any) muſt alſo meaſure the dividend; becauſe the dividend is equal to the ſum of the diviſor multiplied into the quotient, and of the remainder added together. Thus, in the laſt example, $a - b$ meaſures the diviſor $a^2 - b^2$, and the remainder $-2ab + 2b$; it muſt therefore likewiſe meaſure their ſum $a^2 - 2ab + b^2$. You muſt obſerve in this operation to make that the dividend which has the higheſt powers of the letter, according to which the quantities are ranged.

PROBLEM VIII.

To reduce any fraction to its loweſt terms.

RULE. Find the greateſt common meaſure of the numerator and denominator; divide them by that common meaſure, and place the quotients in their room, and you ſhall have a fraction equivalent to the given fraction expreſſed in the leaſt terms.

Thus, $\left.\dfrac{25bc}{25bc}\right)\dfrac{75abc}{125bcx} = \dfrac{3a}{5x}$; $\dfrac{156aa + 156ab}{572aa - 572ab} = \dfrac{3a + 3b}{11a - 11b}$.

When unit is the greateſt common meaſure of the numbers and quantities, then the fraction is already in its loweſt terms. Thus $\dfrac{3ab}{5dc}$ cannot be reduced lower.

And, numbers whoſe greateſt common meaſure is unit, are ſaid to be *prime* to one another.

If a vulgar fraction is to be reduced to a decimal (that is, a fraction whoſe denomination is 10, or any of its powers,) "annex as many cyphers as you pleaſe to the "numerator, and then divide it by the denominator, the "quotient ſhall give a decimal equal to the vulgar fraction propoſed." Thus,

$$\frac{2}{3} = .66666, \text{ \&c.} \qquad \frac{3}{5} = .6;$$

$$\frac{2}{7} = .2857142, \text{ \&c.}$$

Theſe fractions are added and ſubtracted like whole numbers; only care muſt be taken to *ſet ſimilar places above one another*, as units above units, and tenths above tenths, *&c.* They are multiplied and divided as integer numbers; only *there muſt be as many decimal places in the product as in both the multiplicand and multiplier*; and *in the quotient as many as there are in the dividend more than in the diviſor*. And in diviſion the quotient may be continued to any degree of exactneſs you pleaſe, by adding cyphers to the dividend. The ground of theſe operations is eaſily underſtood from the general rules for adding, multiplying, and dividing fractions.

CHAP. VI. *Of the* INVOLUTION *of* QUANTITIES.

THE products ariſing from the continual multiplication of the ſame quantity were called (in Chap. III.) the *powers* of that quantity. Thus, a, a^2, a^3, *&c.* are the powers of a; and ab, a^2b^2, a^3b^3, *&c.* are the powers of ab. In the ſame chapter, the rule for the multiplication of powers of the ſame quantity is, "To "add the exponents, and make their ſum the exponent "of the product." Thus $a^4 \times a^5 = a^9$; and $a^3b^3 \times a^6b^2 = a^9b^5$. In Chap. IV. you have the rule for dividing powers of the ſame quantity, which is "To ſub"tract the exponents, and make the difference the expo"nent of the quotient."

Thus, $\dfrac{a^6}{a^4} = a^{6-4} = a^2$; and $\dfrac{a^5b^3}{a^4b} = a^{5-4}b^{3-1} = ab^2$.

If you divide a leſſer power by a greater, the *exponent of the quotient muſt*, by this rule, *be negative*. Thus,

Thus, $\frac{a^4}{a^6}=a^{4-6}=a^{-2}$. But, $\frac{a^4}{a^6}=\frac{1}{a^2}$; and hence $\frac{1}{a^2}$ is expressed also by a^2 with a negative exponent.

It is also obvious, that $\frac{a}{a}=a^{1-1}=a^0$; but $\frac{a}{a}=1$, and therefore $a^0=1$. After the same manner $\frac{1}{a}=\frac{a^0}{a}=a^{0-1}=a^{-1}$; $\frac{1}{aa}=\frac{a^0}{a^2}=a^{0-2}=a^{-2}$; $\frac{1}{aaa}=a^{0-3}=a^{-3}$; so that the quantities a, 1, $\frac{1}{a}$, $\frac{1}{a^2}$, $\frac{1}{a^3}$, $\frac{1}{a^4}$, *&c.* may be expressed thus, a^1, a^0, a^{-1}, a^{-2}, a^{-3}, a^{-4}, *&c.* Those are called the *negative* powers of a which have negative exponents; but they are at the same time *positive* powers of $\frac{1}{a}$ or a^{-1}.

Negative powers (as well as positive) are multiplied by adding, and divided by subtracting their exponents. Thus the product of a^{-2} (or $\frac{1}{a^2}$) multiplied by a^{-3} (or $\frac{1}{a^3}$) is $a^{-2-3}=a^{-5}$ (or $\frac{1}{a^5}$;) also $a^{-6}\times a^4=a^{-6+4}=a^{-2}$ (or $\frac{1}{a^2}$;) and $a^{-3}\times a^3=a^0=1$. And, in general, *any positive power of* a *multiplied by a negative power of* a *of an equal exponent gives* UNIT *for the product;* for the positive and negative destroy each other, and the product gives a^0, which is equal to unit.

Likewise $\frac{a^{-5}}{a^{-2}}=a^{-5+2}=a^{-3}=\frac{1}{a^3}$; and $\frac{a^{-2}}{a^{-5}}=a^{-2+5}=a^3$. But also, $\frac{a^{-2}}{a^{-5}}=\frac{a^{-2}}{a^{-2}\times a^{-3}}=\frac{1}{a^{-3}}$; therefore $\frac{1}{a^{-3}}=a^3$: And, in general, "Any quantity placed in the denominator of a fraction may be transposed to the numerator, if the sign of its exponent be changed." Thus $\frac{1}{a^3}=a^{-3}$, and $\frac{1}{a^{-3}}=a^3$.

The quantity a^m expresses any power of a in general, the exponent (m) being undetermined; and a^{-m} expresses $\frac{1}{a^m}$, or a negative power of a of an equal exponent: and $a^m\times a^{-m}=a^{m-m}=a^0=1$ is their product. a^n expresses any other power of a; $a^m\times a^n=a^{m+n}$ is the product of the powers a^m and a^n, and a^{m-n} is their quotient.

To raise any simple quantity to its second, third, or fourth power, is to add its exponent twice, thrice, or four times to itself; therefore the second power of any quantity is had by doubling its exponent, and the third by trebling its exponent; and, in general, *the power expressed by* m *of any quantity is had by multiplying the exponent by* m, as is obvi us from the multiplicat on of powers. Thus the second power or square of a is $a^{2\times 1}=a^2$; its third power or cube is $a^{3\times 1}=a^3$; and the m^{th} power of a is $a^{m\times 1}=a^m$. Also, the square of a^4 is $a^{2\times 4}=a^8$; the cube of a^4 is $a^{3\times 4}=a^{12}$; and the m^{th} power of a^4 is $a^{4\times m}$. The square of $a\,b\,c$ is $a^2\,b^2\,c^2$, the cube is $a^3\,b^3\,c^3$, the m^{th} power $a^m\,b^m\,c^m$.

The raising of quantities to any power is called *involution,* and *any simple quantity is involved by multiplying the exponent by that of the power required,* as in the preceding examples.

The coefficient must also be raised to the same power by a continual multiplication of itself by itself, as often as unit is contained in the exponent of the power required. Thus the cube of $3\,a\,b$ is $3\times 3\times 3\times a^3\,b^3=27\,a^3\,b^3$.

As to the signs, *When the quantity to be involved is positive, it is obvious that all its powers must be positive.* And, *when the quantity to be involved is negative, yet all its powers, whose exponents are even numbers, must be positive:* for any number of multiplications of a negative, if the number be even, gives a positive; since $-\times-=+$, therefore $-\times-\times-\times-=+\times+=+$; and $-\times-\times-\times-\times-\times-=+\times+\times+=+$.

The power then only can be negative when its exponent is an odd number, though the quantity to be involved be negative. The powers of $-a$ are $-a$, $+a^2$, $-a^3$, $+a^4$, $-a^5$, *&c.* Those whose exponents are 2, 4, 6, *&c.* are positive; but those whose exponents are 1, 3, 5, *&c.* are negative.

The involution of *compound* quantities is a more difficult operation. The powers of any *binomial* $a+b$ are found by a continual multiplication of it by itself, as follows:

$$
\begin{array}{l}
\quad a+b = \text{Root.}\\
\times\, a+b\\
\hline
a^2+a\,b\\
\quad\ +a\,b+b^2\\
\hline
a^2+2\,a\,b+b^2 = \text{the square or 2d power.}\\
\times\, a\ +b\\
\hline
a^3+2\,a^2\,b+a\,b^2\\
\quad\ +a^2\,b+2\,a\,b^2+b^3\\
\hline
a^3+3\,a^2\,b+3\,a\,b^2+b^3 = \text{cube or 3d power, \&c.}
\end{array}
$$

If the powers of $a-b$ are required, they will be found the same as the preceding, only the terms in which the exponent of b is an odd number, will be found negative; "because an odd number of multiplications of a negative produces a negative." Thus, the cube of $a-b$ will be found to be $a^3-3\,a^2\,b+3\,a\,b^2-b^3$: Where the 2d and 4th terms are negative, the exponent of b being an odd number in these terms. In general, "The terms of any power of $a-b$ are positive and negative by turns."

It is to be observed, That "in the first term of any power of $a\mp b$, the quantity a has the exponent of the power required; that in the following terms, the exponents of a decrease gradually by the same differ-

ence

ence (*viz.* unit), and that in the laſt terms it is never found. The powers of b are in the contrary order; it is not found in the firſt term, but its exponent in the ſecond term is unit, in the third term its exponent is 2; and thus its exponent increaſes, till in the laſt term it becomes equal to the exponent of the power required."

As the exponents of a thus decreaſe, and at the ſame time thoſe of b increaſe, "the ſum of their exponents is always the ſame, and is equal to the exponent of the power required." Thus, in the 6th power of $a+b$, viz. $a^6 + 6a^5b + 15a^4b^2 + 20a^3b^3 + 15a^2b^4 + 6ab^5 + b^6$, the exponents of a decreaſe in this order, 6, 5, 4, 3, 2, 1, 0; and thoſe of b increaſe in the contrary order, 0, 1, 2, 3, 4, 5, 6. And the ſum of their exponents in any term is always 6.

To find the coefficient of any term, the coefficient of the preceding term being known, you are to "divide the coefficient of the preceding term by the exponent of b in the given term, and to multiply the quotient by the exponent of a in the ſame term, increaſed by unit." Thus to find the coefficients of the terms of the 6th power of $a+b$, you find the terms are

$$a^6,\ a^5b,\ a^4b^2,\ a^3b^3,\ a^2b^4,\ ab^5,\ b^6;$$

and you know the coefficient of the firſt term is unit; therefore, according to the rule, the coefficient of the ſecond term will be $\frac{1}{1}\times\overline{5+1}=6$; that of the third term will be $\frac{6}{2}\times\overline{4+1}=3\times5=15$; that of the fourth term will be $\frac{15}{3}\times\overline{3+1}=5\times4=20$; and thoſe of the following will be 15, 6, 1, agreeable to the preceding table.

In general, if $a+b$ is to be raiſed to any power m, the terms, without their coefficients will be a^m, $a^{m-1}b$, $a^{m-2}b^2$, $a^{m-3}b^3$, $a^{m-4}b^4$, ${}^{m-5}b^5$, &c. continued till the exponent of b becomes equal to m.

The coefficients of the reſpective terms, according to the laſt rule, will be

$$1,\ m,\ m\times\frac{m-1}{2},\ m\times\frac{m-1}{2},\times\frac{m-2}{3},\ m\times\frac{m-1}{2}\times\times\frac{m-2}{3}\times\frac{m-3}{4},\ m\times\frac{m-1}{2}\times\frac{m-2}{3}\times\frac{m-3}{4}\times\frac{m-4}{5},$$

&c. continued until you have one coefficient more than there are units in m.

It follows therefore by theſe laſt rules, that $\overline{a+b}^m = a^m + m\,a^{m-1}b + m\times\frac{m-1}{2}\times a^{m-2}b^2 + m\times\frac{m-1}{2}\times\frac{m-2}{3}\times a^{m-3}b^3 + m\times\frac{m-1}{2}\times\frac{m-2}{3}\times\frac{m-3}{4}\times a^{m-4}b^4 +$, &c. which is the general theorem for raiſing a quantity conſiſting of two terms to any power m.

If a quantity conſiſting of three or more terms is to be involved, "you may diſtinguiſh it into two parts, conſidering it as a binomial, and raiſe it to any power by the preceding rules; and then, by the ſame rules, you may ſubſtitute, inſtead of the powers of theſe compound parts, their values." Thus,

$\overline{a+b+c}^2 = \overline{\overline{a+b}+c}^2 = \overline{a+b}^2 + 2c\times\overline{a+b} + c^2 = a^2 + 2ab + b^2 + 2ac + 2bc + c^2$.

In theſe examples, $a+b+c$ is conſidered as compoſed of the compound part $a+b$ and the ſimple part c; and then the powers of $a+b$ are formed by the preceding rules, and ſubſtituted for $\overline{a+b}^3$ and $\overline{a+b}^2$.

CHAP. VII. *Of* EVOLUTION.

THE reverſe of involution, or the reſolving of powers into their roots, is called *evolution*. The roots of ſingle quantities are eaſily extracted "by dividing their exponents by the number that denominates the root required." Thus, the ſquare root of a^8 is $a^{\frac{8}{2}}=a^4$; and the ſquare root of $a^4b^8c^2$ is a^2b^4c. The cube root of a^6b^3 is $a^{\frac{6}{3}}b^{\frac{3}{3}}=a^2b$; and the cube root of $x^9y^6z^{12}$ is $x^3y^2z^4$. The ground of this rule is obvious from the rule for involution. The powers of any root are found by multiplying its exponent by the index that denominates the power; and therefore, when any power is given, the root muſt be found by dividing the exponent of the given power by the number that denominates the kind of root that is required.

It appears, from what was ſaid of involution, that "any power that has a poſitive ſign may have either a poſitive or negative root, if the root is denominated by any even number." Thus the ſquare-root of $+a^2$ may be $+a$ or $-a$, becauſe $+a\times+a$ or $-a\times-a$ gives $+a^2$ for the product.

But if a power have a negative ſign, "no root of it denominated by an even number can be be aſſigned," ſince there is no quantity that multiplied into itſelf an even number of times can give a negative product. Thus the ſquare root of $-a^2$ cannot be aſſigned, and is what we call an *impoſſible* or *imaginary* quantity.

But if the root to be extracted is denominated by an *odd* number, then ſhall "the ſign of the root be the ſame as the ſign of the given number whoſe root is required." Thus the cube root of $-a^3$ is $-a$, and the cube root of $-a^6b^3$ is $-a^2b$.

If the number that denominates the root required is a diviſor of the exponent of the given power, then ſhall the root be only a *lower power of the ſame quantity*. As the cube root of a^{12} is a^4, the number 3 that denominates the cube root being a diviſor of 12.

But if the number that denominates what ſort of root is required is not a diviſor of the exponent of the given power, "then the root required ſhall have a fraction for its exponent." Thus the ſquare root of a^3 is $a^{\frac{3}{2}}$; the cube root of a^5 is $a^{\frac{5}{3}}$, and the ſquare root of a itſelf is $a^{\frac{1}{2}}$.

Theſe powers that have fractional exponents are called *imperfect powers* or *ſurds*; and are otherwiſe expreſſed by placing the given power within the radical ſign $\sqrt{}$, and placing above the radical ſign the number that denominates what kind of root is required. Thus $a^{\frac{3}{2}}=\sqrt[2]{a^3}$, $a^{\frac{5}{3}}=\sqrt[2]{a^5}$; and $a^{\frac{m}{n}}=\sqrt[n]{a^m}$. In numbers the ſquare root of 2 is expreſſed by $\sqrt[2]{2}$, and the cube root of 4 by $\sqrt[3]{4}$.

The

The ſquare root of any compound quantity, as $a^2+2ab+b^2$ is diſcovered after this manner. "Firſt, "take care to diſpoſe the terms according to the dimen-"ſions of the alphabet, as in diviſion; then find the "ſquare root of the firſt term aa, which gives a for the "firſt member of the root. Then ſubtract its ſquare "from the propoſed quantity, and divide the firſt term "of the remainder ($2ab+b^2$) by the double of that mem-"ber, *viz.* $2a$, and the quotient b is the ſecond member "of the root. Add this ſecond member to the double "of the firſt, and multiply their ſum ($2a+b$) by the ſe-"cond member b, and ſubtract the product ($2ab+b^2$) "from the foreſaid remainder ($2ab+b^2$) and if nothing "remains, then the ſquare root is obtained;" and in this example it is found to be $a+b$.

The manner of the operation is thus,

$$
\begin{array}{r|l}
 & a^2+2ab+b^2\ (a+b \\
 & a^2 \\
\hline
2a+b & 2ab+b^2 \\
\times b & 2ab+b^2 \\
\hline
 & 0\ .\ 0
\end{array}
$$

"But if there had been a remainder, you muſt have "divided it by the double of the ſum of the two parts "already found, and the quotient would have given the "third member of the root."

Thus, if the quantity propoſed had been $a^2+2ab+2ac+b^2+2bc+c^2$, after proceeding as above, you would have found the remainder $2ac+2bc+c^2$, which divided by $2a+2b$ gives c to be annexed to $a+b$ as the 3d member of the root. Then adding c to $2a+2b$, and multiplying their ſum $2a+2b+c$ by c, ſubtract the product $2ac+2bc+c^2$ from the foreſaid remainder; and ſince nothing now remains, you conclude that $a+b+c$ is the ſquare root required.

The ſquare root of any number is found out after the ſame manner. If it is a number under 100, its neareſt ſquare root is found by the following table; by which alſo its cube root is found if it be under 1000, and is biquadrate if it be under 10000.

The root	1	2	3	4	5	6	7	8	9
Square	1	4	9	16	25	36	49	64	81
Cube	1	8	27	64	125	216	343	512	729
Biquad.	1	16	81	256	625	1296	2401	4096	6561

But if it is a number above 100, then its ſquare root will conſiſt of two or more figures, which muſt be found by different operations by the following

RULE.

"To find the ſquare root of any number, place a "point above the number that is in the place of units, "paſs the place of tens, and place again a point over that "of hundreds, and go on towards the left hand placing a "point over every 2d figure; and by theſe points the "number will be diſtinguiſhed into as many parts as "there are figures in the root. Then find the ſquare "root of the firſt part, and it will give the firſt figure of "the root; ſubtract its ſquare from that part, and an-"nex the ſecond part of the given number to the re-"mainder. Then divide this new number (neglecting "its laſt figure) by the double of the firſt figure of the "root, annex the quotient to that double, and multiply "the number thence ariſing by the ſaid quotient, and if "the product is leſs than your dividend, or equal to it, "that quotient ſhall be the ſecond figure of the root. "But if the product is greater than the dividend, you "muſt take a leſs number for the ſecond figure of "the root than that quotient." Much after the ſame manner may the other figures of the quotient be found, if there are more points than two placed over the given number.

To find the ſquare root of 99856, firſt point it thus, $\dot{9}9\dot{8}5\dot{6}$; then find the ſquare root of 9 to be 3, which therefore is the firſt figure of the root; ſubtract 9, the ſquare of 3, from 9, and to the remainder annex the ſecond part 98, and divide (neglecting the laſt figure 8) by the double of 3, or 6, and place the quotient after 6, and then multiply 61 by 1, and ſubtract the product 61 from 98. Then to the remainder (37) annex the laſt part of the propoſed number (56), and dividing 3756 (neglecting the laſt figure 6) by the double of 31, that is by 62, place the quotient after, and multiplying 626 by the quotient 6, you will find the product to be 3756, which ſubtracted from the dividend, and leaving no remainder, the exact root muſt be 316.

EXAMP.

$$
\begin{array}{r|l}
 & \dot{9}9\dot{8}5\dot{6}\ (316 \\
 & 9 \\
\hline
61 & 98 \\
\times 1 & 61 \\
\hline
626 & 3756 \\
\times 6 & 3756 \\
\hline
 & 0
\end{array}
$$

In general, to extract any root out of any given quantity, "Firſt range that quantity according to the dimen-"ſions of its letters, and extract the ſaid root out of the "firſt term, and that ſhall be the firſt member of the "root required. Then raiſe this root to a dimenſion "lower by unit than the number that denominates the "root required, and multiply the power that ariſes by "that number itſelf; divide the ſecond term of the "given quantity by the product, and the quotient ſhall "give the ſecond member of the root required."

Thus to extract the root of the 5th power out of $a^5+5a^4b+10a^3b^2+10a^2b^3+5ab^4+b^5$, I find, that the root of the 5th power out of a^5 gives a, which I raiſe to the 4th power, and multiplying by 5, the product is $5a^4$; then dividing the ſecond term of the given quantity $5a^4b$ by $5a^4$, I find b to be the ſecond member; and raiſing $a+b$ to the 5th power, and ſubtracting it, there being no remainder, I conclude that $a+b$ is the root required. If the root has three members, the third is found after the ſame manner from the firſt two conſidered as one member, as the ſecond member was found from the firſt; which may be eaſily underſtood from what was ſaid of extracting the ſquare root.

In

In extracting roots it will often happen that the exact root cannot be found in finite terms; thus the square root of $a^2 + x^2$ is found to be

$$a + \frac{x^2}{2a} - \frac{x^4}{8a^3} + \frac{x^6}{16a^5} - \frac{5x^8}{128a^7} +, \text{ \&c.}$$

The operation is thus;

$$a^2+x^2 \left(a+\frac{x^2}{2a} - \frac{x^4}{8a^3} + \frac{x^6}{16a^5} -, \text{ \&c.}\right.$$

$$a^2$$

$$\left.2a+\frac{x^2}{2a}\right)\ {}^{*} + x^2$$

$$\left.\times\frac{x^2}{2a}\right) = x^2 + \frac{x^4}{4a^2}$$

$$\left.2a+\frac{x^2}{a} - \frac{x^4}{8a^3}\right) - \frac{x^4}{4a^2}$$

$$\left.\times - \frac{x^4}{8a^3}\right) = -\frac{x^4}{4a^2} - \frac{x^6}{8a^4} + \frac{x^8}{64a^6}$$

$$+\frac{x^6}{8a^4} - \frac{x^8}{64a^6}.$$

&c.

"The general theorem which we gave for the involution of binomials will serve also for their evolution;" because to extract any root of a given quantity is the same thing as to raise that quantity to a power whose exponent is a fraction that has its denominator equal to the number that expresses what kind of root is to be extracted. Thus, to extract the square root of $a + b$ is to raise $a + b$ to a power whose exponent is $\frac{1}{2}$.

The roots of numbers are to be extracted as those of algebraic quantities. "Place a point over the units, "and then place points over every third, fourth, or "fifth figure towards the left hand, according as it is "the root of the cube, of the 4th or 5th power that is "required; and, if there be any decimals annexed to "the number, point them after the same manner, pro"ceeding from the place of units towards the right"hand. By this means the number will be divided in"to so many periods as there are figures in the root re"quired. Then inquire which is the greatest cube, "biquadrate, or 5th power in the first period, and the "root of that power will give the first figure of the root "required. Subtract the greatest cube, biquadrate, or "5th power, from the first period, and to the remainder "annex the first figure of your second period, which "shall give your dividend.

"Raise the first figure already found to a power less "by unit than the power whose root is sought, that is, "to the 2d, 3d, or 4th power, according as it is the "cube root, the root of the 4th, or the root of the "5th power that is required, and multiply that power "by the index of the cube, 4th, or 5th power, and di"vide the dividend by this product, so shall the quo"tient be the second figure of the root required.

"Raise the part already found of the root, to the "power whose root is required, and if that power be "found less than the two first periods of the given num"ber, the second figure of the root is right. But, if "it be found greater, you must diminish the second fi"gure of the root till that power be found equal to or "less than those periods of the given number. Sub"tract it, and to the remainder annex the next period; "and proceed till you have gone through the whole gi"ven number, finding the third figure by means of the "two first, as you found the second by the first; and "afterwards finding the fourth figure (if there be a "fourth period) after the same manner from the three "first."

Thus to find the cube root of 13824, point it $1\dot{3}82\dot{4}$; find the greatest cube in 13, *viz.* 8, whose cube root 2 is the first figure of the root required. Subtract 8 from 13, and to the remainder 5 annex 8, the first figure of the second period; divide 58 by triple the square of 2, *viz.* 12, and the quotient is 4, which is the second figure of the root required, since the cube of 24 gives 13824, the number proposed. After the same manner the cube root of 13312053 is found to be 237.

$$\begin{array}{rl}
 & 1\dot{3}82\dot{4}\ (24 \\
\text{Subtr.} & 8 = 2\times2\times2 \\
\hline
3\times4 = 12)\ 58\ (4 & \\
\text{Subtr.} & 24\times24\times24 = 13824 \\
\hline
\text{Rem.} & \ldots\ 0\ .
\end{array}$$

In extracting of roots, after you have gone through the number proposed, if there is a remainder, you may continue the operation by adding periods of cyphers to that remainder, and find the true root in decimals to any degree of exactness.

CHAP. VIII. *Of* PROPORTION.

WHEN quantities of the same kind are compared, it may be considered, either how much the one is greater than the other, and what is their *difference*; or, it may be considered how many times the one is contained in the other; or, more generally, what is their *quotient*. The first relation of quantities is expressed by their *arithmetical ratio*; the second by their *geometrical ratio*. That term whose ratio is inquired into is called the *antecedent*, and that with which it is compared is called the *consequent*.

When of four quantities the difference betwixt the first and second is equal to the difference betwixt the third and fourth, those quantities are called *arithmetical proportionals*; as the numbers 3, 7, 12, 16. And the quantities a, $a+b$, e, $e+b$. But quantities form a *series* in arithmetical proportion, when they "increase or "decrease by the same constant difference." As these, a, $a+b$, $a+2b$, $a+3b$, $a+4b$, &c. x, $x-b$, $x-2b$, &c. or the numbers 1, 2, 3, 4, 5, &c. and 10, 7, 4, 1, −2, −5, −8, &c.

In four quantities *arithmetically proportional*, "the "sum of the extremes is equal to the sum of the mean "terms."

" terms." Thus, a, $a+b$, e, $e+b$, are arithmetical proportionals, and the sum of the extremes $(a+e+b)$ is equal to the sum of the mean terms $(a+b+e)$. Hence, to find the fourth quantity arithmetically proportional to any three given quantities; " Add the second and third, " and from their sum subtract the first term, the remain- " der shall give the fourth arithmetical proportional re- " quired."

In a *series* of arithmetical proportionals, " the sum of " the first and last terms is equal to the sum of any two " terms equally distant from the extremes." If the first terms are a, $a+b$, $a+2b$, *&c.* and the last term x, the last term but one will be $x-b$, the last but two $x-2b$, the last but three $x-3b$, *&c.* So that the first half of the terms, having those that are equally distant from the last term set under them, will stand thus;

$$\begin{array}{cccccc} a, & a+b, & a+2b, & a+3b, & a+4b, & \text{\&c.} \\ x, & x-b, & x-2b, & x-3b, & x-4b, & \\ \hline a+x, & a+x, & a+x, & a+x, & a+x, & \text{\&c.} \end{array}$$

And it is plain, that if each term be added to the term above it, the sum will be $a+x$, equal to the sum of the first term a and the last term x. From which it is plain, that " the sum of all the terms of an arithmetical pro- " gression is equal to the sum of the first and last taken " half as often as there are terms;" that is, the sum of an arithmetical progression is equal to the sum of the first and last terms multiplied by half the number of terms. Thus, in the preceding series, if n be the number of terms, the sum of all the terms will be $\overline{a+x} \times \frac{n}{2}$.

The common difference of the terms being b, and b not being found in the first term, it is plain that " its " coefficient in any term will be equal to the number of " terms that precede that term " Therefore in the last term x you must have $\overline{n-1} \times b$, so that x must be equal to $a+\overline{n-1} \times b$. And the sum of all the terms being $\overline{a+x} \times \frac{n}{2}$, *it will also be equal to* $\frac{2an+n^2b-nb}{2}$, *or to* $a+\frac{nb-b}{2} \times n$. Thus for example, the series $1+2+3+4+5$, &c. continued to a hundred, must be equal to $\frac{2\times 100+10000-100}{2}=5050$.

If a series have (o) nothing for its first term, then " its sum shall be equal to half the product of the last " term multiplied by the number of terms." For then a being $=0$, the sum of the terms, which is in general $\overline{a+x} \times \frac{n}{2}$, will in this case be $\frac{nx}{2}$. From which it is evident, that " the sum of any number of arithmetical " proportionals beginning from nothing, is equal to half " the sum of as many terms equal to the greatest term." Thus,

$$0+1+2+3+4+5+6+7+8+9= \\ =\frac{9+9+9+9+9+9+9+9+9+9}{2}=\frac{10\times 9}{2}=45.$$

" If of four quantities the quotient of the *first* and *se-* " *cond* be equal to the quotient of the *third* and *fourth*, " then those quantities are said to be in *geometrical* " *proportion*." Such are the numbers 2, 6, 4, 12; and the quantities a, ar, b, br; which are expressed after this manner;

$$2 : 6 :: 4 : 12.$$
$$a : ar :: b : br.$$

And you read them by saying, As 2 is to 6, so is 4 to 12; or, as a is to ar, so is b to br.

In four quantities geometrically proportional, " the " product of the extremes is equal to the product of the " middle terms." Thus, $a \times br = ar \times b$. And, if it is required to find a fourth proportional to any three given quantities, " multiply the second by the third, and di- " vide their product by the first, the quotient shall give " the fourth proportional required." Thus, to find a fourth proportional to a, ar, and b, multiply ar by b, and divide the product arb by the first term a, the quotient br is the fourth proportional required.

In calculations it sometimes requires a little care to place the terms in due order; for which you may observe the following

RULE. First set down the quantity that is of the same kind with the quantity sought; then consider, from the nature of the question, whether that which is given is greater or less than that which is sought; if it is greater, then place the greatest of the other two quantities on the left hand; but if it is less, place the least of the other two quantities on the left hand, and the other on the right.

Then shall the terms be in due order; and you are to proceed according to the rule, multiplying the second by the third, and dividing their product by the first.

EXAMP. " If 30 men do any piece of work in 12 " days, how many men shall do it in 18 days?"

Because it is a number of men that is sought, first set down 30, the number of men that is given: you will easily see that the number that is given is greater than the number that is sought; therefore place 18 on the left hand, and 12 on the right; and find a 4th proportional to 18, 30, 12, *viz.* $\frac{30 \times 12}{18}=20$.

When a series of quantities increase by one common multiplicator, or decrease by one common divisor, they are said to be in *geometrical proportion continued.*

As, a, ar, ar^2, ar^3, ar^4, ar^5, &c. or,

$$a, \frac{a}{r}, \frac{a}{r^2}, \frac{a}{r^3}, \frac{a}{r^4}, \frac{a}{r^5}, \text{ \&c.}$$

The common multiplier or divisor is called their *common ratio.*

In such a series, " the product of the first and last " is always equal to the product of the second and last " but one, or to the product of any two terms equal- " ly remote from the extremes." In the series, a, ar, ar^2, ar^3, &c. if y be the last term, then shall the four last terms of the series be y, $\frac{y}{r}$, $\frac{y}{r^2}$, $\frac{y}{r^3}$; now it is plain, that $a \times y = ar \times \frac{y}{r} = ar^2 \times \frac{y}{r^2} = ar^3 \times \frac{y}{r^3}$, &c.

" The

"The ſum of a ſeries of geometrical proportionals "wanting the firſt term, is equal to the ſum of all "but the laſt term multiplied by the common ratio."

$$\text{For } \overline{ar+ar^2+ar^3, \&c. + \frac{y}{r^3}+\frac{y}{r^2}+\frac{y}{r}+y=}$$
$$=r\times a+ar+ar^2, \&c. +\frac{y}{r^4}+\frac{y}{r^3}+\frac{y}{r^2}+\frac{y}{r}.$$

Therefore if s be the ſum of the ſeries, $s-a$ will be equal to $\overline{s-y}\times r$; that is, $s-a=sr-yr$, or $sr-s=yr-a$, and $s=\frac{yr-a}{r-1}$.

Since the exponent of r is always increaſing from the ſecond term, if the number of terms be n, in the laſt term its exponent will be $n-1$. Therefore $y=ar^{n-1}$; and $yr=ar^{n-1\times 1}=ar^n$; and $s=\left(\frac{yr-a}{r-1}\right)=\frac{ar^n-a}{r-1}$. So that having the firſt term of the ſeries, the number of the terms, and the common ratio, you may eaſily find the ſum of all the terms.

If it is a decreaſing ſeries whoſe ſum is to be found, as of $y+\frac{y}{r}+\frac{y}{r^2}+\frac{y}{r^3}$, &c. $+ar^3+ar^2+ar+a$, and the number of the terms be ſuppoſed infinite, then ſhall a, the laſt term, be equal to nothing. For, becauſe n, and conſequently r^{n-1} is infinite, $a=\frac{r}{r^{n-1}}=0$. The ſum of ſuch a ſeries $s=\frac{yr}{r-1}$; which is a finite ſum, though the number of terms be infinite. Thus,

$$1+\tfrac{1}{2}+\tfrac{1}{4}+\tfrac{1}{8}+\tfrac{1}{16}+, \&c. =\frac{1\times 2}{2-1}=2.$$

$$\text{and } 1+\tfrac{1}{3}+\tfrac{1}{9}+\tfrac{1}{27}+\tfrac{1}{81}+, \&c. =\frac{1\times 3}{3-1}=\tfrac{3}{2}$$

CHAP. IX. *Of* EQUATIONS *that involve only one unknown Quantity.*

AN *equation* is "a propoſition aſſerting the equality "of two quantities." It is expreſſed moſt commonly by ſetting down the quantities, and placing the ſign (=) between them.

An equation gives the value of a quantity, when that quantity is alone on one ſide of the equation: and that value is known, if all thoſe that are on the other ſide are known. Thus if I find that $x=\frac{4\times 6}{3}=8$, I have a known value of x. Theſe are the laſt concluſions we are to ſeek in queſtions to be reſolved; and if there be only one unknown quantity in a given equation, and only one dimenſion of it, ſuch a value may always be found by the following rules.

RULE I. Any quantity may be tranſpoſed from one ſide of the equation to the other, if you change its ſign.

For to take away a quantity from one ſide, and to place it with a contrary ſign on the other ſide, is to ſubtract it from both ſides; and it is certain, that "when from equal quantities you ſubtract the ſame quantity, the remainders muſt be equal."

By this rule, when the known and unknown quantities are mixed in an equation, you may ſeparate them by bringing all the unknown to one ſide, and the known to the other ſide of the equation; as in the following examples,

Suppoſe $5x+50=4x+56$
by Tranſpoſit. $5x-4x=56-50$, or, $x=6$
And if $2x+a=x+b$
$2x-x=b-a$, or, $x=b-a$.

RULE II. Any quantity by which the unknown quantity is multiplied may be taken away, if you divide all the other quantities on both ſides of the equation by it.

For that is to divide both ſides of the equation by the ſame quantity, and when you divide equal quantities by the ſame quantity, the quotients muſt be equal. Thus,

If $ax=b$
then $x=\frac{b}{a}$;

and if $3x+12=27$
by Rule 1ſt. $3x=27-12=15$
and by Rule 2d. $x=\frac{15}{3}=5$

RULE III. If the unknown quantity is divided by any quantity, that quantity may be taken away if you multiply all the other members of the equation by it. Thus,

If $\frac{x}{b}=b+5$
then ſhall $x=bb+5b$

By this rule, an equation whereof any part is a fraction may be reduced to an equation that ſhall be expreſſed by integers. If there are more fractions than one in the given equation, you may, by reducing them to a common denominator, and then multiplying all the other terms by that denominator, abridge the calculation thus;

If $\frac{x}{5}+\frac{x}{3}=x-7$
then $\frac{3x+5x}{15}=x-7$
and by this Rule $3x+5x=15x-105$
and by R. 1. and 2. $x=\frac{105}{7}=15$.

RULE IV. If that member of the equation that involves the unknown quantity be a *ſurd* root, then the equation is to be reduced to another that ſhall be free from any ſurd, by bringing that member firſt to ſtand alone upon one ſide of the equation, and then taking away the radical ſign from it, and raiſing the other ſide of the equation to the power denominated by the ſurd.

Thus if $\sqrt{4x+16}=12$
$4x+16=144$
and $4x=144-16=128$
and $x=\frac{128}{4}=32$.

RULE

RULE V. If that ſide of the equation that contains the unknown quantity be a compleat ſquare, cube, or other power; then extract the ſquare root, cube root, or the root of that power, from both ſides of the equation, and thus the equation ſhall be reduced to one of a lower degree.

If $x^2+6x+9=20$
then $x+3=\pm\sqrt{20}$
and $x=\pm\sqrt{20}-3$.

RULE VI. A proportion may be converted into an equation aſſerting the product of the extreme terms equal to the product of the mean terms; or any one of the extremes equal to the product of the means divided by the other extreme.

If $12-x : \frac{x}{2} :: 4 : 1$
then $12-x=2x$ . . . . $3x=12$ . . . and $x=4$.

Or if $20-x : x :: 7 : 3$
then $60-3x=7x$ . . . . $10x=60$ . . . and $x=6$.

RULE VII. If any quantity be found on both ſides of the equation with the ſame ſign prefixed, it may be taken away from both: Alſo, if all the quantities in the equation are multiplied or divided by the ſame quantity, it may be ſtruck out of them all. Thus,

If $3x+b=a+b$ . . . $3x=a$ . . . and $x=\frac{a}{3}$.

RULE VIII. Inſtead of any quantity in an equation, you may ſubſtitute another equal to it.

Thus if $3x+y=24$
and $y=9$
then $3x+9=24$ . . . $x=\frac{24-9}{3}=5$.

The further improvements of this rule ſhall be taught in the following chapter.

CHAP. X. *Of the* SOLUTION *of* QUESTIONS *that produce* SIMPLE EQUATIONS.

SIMPLE equations are thoſe "wherein the unknown quantity is only of one dimenſion." In the ſolution of which, we are to obſerve the following directions.

DIRECT. I. "After forming a diſtinct idea of the "queſtion propoſed, the unknown quantities are to be "expreſſed by letters, and the particulars to be tranſla-"ted from the common language into the algebraic "manner of expreſſing them, that is, into ſuch equations "as ſhall expreſs the relations or properties that are "given of ſuch quantities."

Thus, if the ſum of two quantities muſt be 60, that condition is expreſſed thus, . . . $x+y=60$.
If their difference muſt be 24, that condition gives . . . . . . $x-y=24$.
If their product muſt be 1640, then . . . $xy=1640$.
If their quotient muſt be 6, then . . . $\frac{x}{y}=6$.
If their proportion is as 3 to 2, then $x:y::3:2$ or $2x=3y$; becauſe the product of the extremes is equal to the product of the mean terms.

DIRECT. II. "After an equation is formed, if you "have one unknown quantity only, then, by the rules "of the preceding chapter, bring it to ſtand alone on "one ſide, ſo as to have only known quantities on the "other ſide:" thus you ſhall diſcover its value.

EXAMP. "A perſon being aſked what was his age, "anſwered that $\frac{3}{4}$ of his age multiplied by $\frac{1}{12}$ of his age "gives a product equal to his age. *Qu.* What was "his age?"

It appears from the queſtion, that if you call his age x, then ſhall . . . $\frac{3x}{4}\times\frac{x}{12}=x$
that is . . . $\frac{3x^2}{48}=x$
and by Rule 3. . . . $3x^2=48x$
and by R. 7. . . . $3x=48$
whence by R. 2. . . . $x=16$.

DIRECT. III. "If there are two unknown quanti-"ties, then there muſt be two equations ariſing from the "conditions of the queſtion: Suppoſe the quantities x "and y; find a value of x or y from each of the equa-"tions, and then, by putting theſe two values equal to "each other, there will ariſe a new equation involving "one unknown quantity; which muſt be reduced by the "rules of the former chapter."

EXAMP. I. "Let the ſum of two quantities be s, "and their difference d. Let s and d be given, and let "it be required to find the quantities themſelves." Suppoſe them to be x and y, then, by the ſuppoſition,

$$x+y=s$$
$$x-y=d$$
$$\text{whence} \begin{cases} x=s-y \\ x=d+y \end{cases}$$
$$\text{and } d+y=s-y$$
$$2y=s-d$$
$$y=\frac{s-d}{2}$$
$$\text{and } x=\frac{s+d}{2}.$$

EXAMP. II. "A privateer running at the rate of 10 "miles an hour, diſcovers a ſhip 18 miles off making "way at the rate of 8 miles an hour: It is demanded "how many miles the ſhip can run before ſhe be over-"taken?"

Let the number of miles the ſhip can run before ſhe be overtaken be called x, and the number of miles the privateer muſt run before ſhe come up with the ſhip be y; then ſhall (by ſupp.) . . $y=x+18$ . . . and $x:y::8:10$. whence

whence $10x=8y$ . . . $x=\frac{4y}{5}$ . . and $x=y-18$. whence $y-18=\frac{4y}{5}$ and $y=90$ . . $x=y-18=72$.

To find the time, ſay, If 8 miles give 1 hour, 72 miles will give 9 hours . . thus, $8:1::72:9$.

Examp. III. "Suppoſe the diſtance between London "and Edinburgh to be 360 miles; and that a courier ſets "out from Edinburgh, running at the rate of 10 miles "an hour; another ſets out at the ſame time from Lon- "don, and runs 8 miles an hour: It is required to know "where they will meet?"

Suppoſe the courier that ſets out from Edinburgh runs x miles, and the other y miles, before they meet, then ſhall,

$$\text{by ſuppoſ.}\begin{cases} x+y=360 \\ x:y::5:4 \end{cases}$$

$$\begin{aligned} &x=\frac{5y}{4} \\ &x=360-y \\ &\frac{5y}{4}=360-y \\ &\frac{5y}{4}+y=360 \\ &9y=1440 \\ &y=\tfrac{1440}{9}=160 \\ &x=360-y=200 \end{aligned}$$

Examp. IV. "Two merchants were copartners; "the ſum of their ſtock was 300 l. One of their ſtocks "continued in company 11 months, but the other drew "out his ſtock in 9 months; when they made up their "accounts they divided the gain equally. *Qu.* What "was each man's ſtock?" Suppoſe the ſtock of the firſt to be x, and the ſtock of the other to be y; then,

$$\text{by ſuppoſ.}\begin{cases} x+y=300 \\ 11x=9y \end{cases}$$

$$\begin{aligned} &x=\frac{9y}{11}=300-y \\ &11y+9y=3300 \\ &20y=3300 \\ &y=\tfrac{3300}{20}=165\ldots x=300-y=135. \end{aligned}$$

Direct. IV. "When in one of the given equa- "tions the unknown quantity is of one dimenſion, and "in the other of a higher dimenſion; you muſt find a "value of the unknown quantity from that equation "where it is of one dimenſion, and then raiſe that va- "lue to the power of the unknown quantity in the other "equation; and by comparing it, ſo involved, with the "value you deduce from that other equation, you ſhall "obtain an equation that will have only one unknown "quantity, and its powers."

That is, when you have two equations of different dimenſions, if you cannot reduce the higher to the ſame dimenſion with the lower, you muſt raiſe the lower to the ſame dimenſion with the higher.

Examp. V. "The ſum of two quantities, and the "difference of their ſquares, being given, to find the "quantities." Suppoſe them to be x and y, their ſum s, and the difference of their ſquares d. Then,

$$\begin{aligned} &\begin{cases} x+y=s \\ x^2-y^2=d \end{cases} \\ &x=s-y \\ &x^2=s^2-2sy+y^2 \\ &x^2=d+y^2,\ \text{whence } * \end{aligned} \qquad \begin{aligned} &*d+y^2=s^2-2sy+y^2 \\ &d=s^2-2sy \\ &2sy=s^2-d \\ &y=\frac{s^2-d}{2s} \\ &\text{and } x=\frac{s^2+d}{2s}. \end{aligned}$$

Direct. V. "If there are three unknown quanti- "ties, there muſt be three equations in order to deter- "mine them, by comparing which, you may, in all caſes, "find two equations involving only two unknown quan- "tities; and then, by *Direct.* 3d, from theſe two you "may deduce an equation involving only one unknown "quantity; which may be reſolved by the rules of the "laſt chapter."

From three equations involving any three unknown quantities, x, y, and z, to deduce two equations, involving only two unknown quantities, the following rule will always ſerve.

Rule. "Find three values of x from the three given equations; then, by comparing the firſt and ſecond value, you will find an equation involving only y and z; again, by comparing the firſt and third, you will find another equation involving only y and z; and, laſtly, thoſe equations are to be reſolved by *Dir.* 3.

Examp. VI.

$$\text{Suppoſe}\ \left.\begin{aligned} &x+y+z=12 \\ &x+2y+3z=20 \\ &\frac{x}{3}+\frac{y}{2}+z=6 \end{aligned}\right\}\ \text{then, } x=\left\{\begin{aligned} &12-y-z \\ &20-2y-3z \\ &18-\frac{3y}{2}-3z \end{aligned}\right\}\left.\begin{aligned} &\text{1ſt} \\ &\text{2d} \\ &\text{3d} \end{aligned}\right\}\text{Value.}$$

$$\begin{aligned} &12-y-z=20-2y-3z \\ &12-y-z=18-\frac{3y}{2}-3z \end{aligned}$$

Theſe two laſt equations involve only y and z, and are to be reſolved by *Direct.* 3d, as follows,

$$\begin{cases} 2y-y+3z-z=20-12=8 \\ y+2z=8 \end{cases}$$

$$\begin{aligned} &36-3y-6z=24-2y-2z \\ &12=y+4z \\ &\text{whence } y=\begin{cases} 8-2z\ \ .\ .\ \text{1ſt value} \\ 12-4z\ \ .\ .\ \text{2d value} \end{cases} \\ &8-2z=12-4z \\ &2z=12-8=4 \\ \text{and}\quad &z=2 \\ &y(=8-2z)=4 \\ &x(=12-y-z)=6. \end{aligned}$$

This method is general, and will extend to all equations that involve 3 unknown quantities: but there are often

often easier and shorter methods to deduce an equation involving one unknown quantity only; which will be best learned by practice.

EXAMP. VII. Supp. $\begin{cases} x+y=a \\ x+z=b \\ y+z=c \end{cases}$

$$x=a-y$$
$$a-y+z=b$$
$$y+z=c$$

$$a+0+2z=b+c$$
$$2z=b+c-a$$
$$\begin{cases} z=\dfrac{b+c-a}{2} \\ y\ (=c-z)=\dfrac{c+a-b}{2} \\ x\ (=a-y)=\dfrac{a+b-c}{2}. \end{cases}$$

It is obvious from the 3d and 5th directions, in what manner you are to work if there are four, or more, unknown quantities, and four, or more, equations given. By comparing the given equations, you may always at length discover an equation involving only one unknown quantity; which, if it is a simple equation, may always be resolved by the rules of the last chapter. We may conclude then, that "When there are as many simple equations given as quantities required, these quantities may be discovered by the application of the preceding rules."

If indeed there are more quantities required than equations given, then the question is not limited to determinate quantities; but is capable of an infinite number of solutions. And, if there are more equations given than there are quantities required, it may be impossible to find the quantities that will answer the conditions of the question; because some of these conditions may be inconsistent with others.

CHAP. XI. *Containing some general* THEOREMS *for the exterminating unknown* QUANTITIES *in given* EQUATIONS.

IN the following *Theorems*, we call those coefficients of the *same order* that are prefixed to the same unknown quantities in the different equations. Thus in *Theor.* 2d, a, d, g, are of the same order, being the coefficients of x: also b, e, h, are of the same order, being the coefficients of y: and those are of the same order that affect no unknown quantity.

But those are called *opposite* coefficients that are taken each from a different equation, and from a different order of coefficients: As, a, e, and d, b, in the first theorem; and a, e, k, in the second; also, a, h, f; and d, b, k, &c.

THEOREM I.

Suppose that two equations are given, involving two unknown quantities, as,

$$\begin{cases} ax+by=c \\ dx+ey=f \end{cases}$$

then shall $y=\dfrac{af-dc}{ae-db}$;

where the numerator is the difference of the products of the opposite coefficients in the orders in which y is not found, and the denominator is the difference of the products of the opposite coefficients taken from the orders that involve the two unknown quantities.

For, from the first equation, it is plain, that

$$ax=c-by \;..\; \text{and } x=\frac{c-by}{a}$$

from the 2d, $dx=f-ey$ .. and $x=\dfrac{f-ey}{d}$

therefore $\dfrac{c-by}{a}=\dfrac{f-ey}{d}$, and $cd-dby=af-aey$

whence $aey-dby=af-cd$,

and $y=\dfrac{af-cd}{ae-db}$,

after the same manner, $x=\dfrac{ce-bf}{ae-db}$.

EXAMP. Supp. $\begin{cases} 5x+7y=100 \\ 3x+8y=\ 80 \end{cases}$

then $y=\dfrac{5\times80-3\times100}{5\times8-3\times7}=\dfrac{100}{19}=5\,\dfrac{5}{19}$

and $x=\dfrac{240}{19}=12\,\dfrac{12}{19}$.

THEOREM II.

SUPPOSE now that there are three unknown quantities and three equations, then call the unknown quantities x, y, and z.

Thus,

$$\begin{cases} ax+by+cz=m \\ dx+ey+fz=n \\ gx+hy+kz=p \end{cases}$$

Then shall $z=\dfrac{aep-ahn+dhm-dbp+gbn-gem}{aek-ahf+dhc-dbk+gbf-gec}$;

where the numerator consists of all the different products that can be made of three opposite coefficients taken from the orders in which z is not found, and the denominator consists of all the products that can be made of the three opposite coefficients taken from the orders that involve the three unknown quantities.

CHAP. XII. *Of Quadratic* EQUATIONS.

IN the solution of any question, where you have got an equation that involves one unknown quantity, but in-

volves at the same time the square of that quantity, and the product of it multiplied by some known quantity, then you have what is called a *Quadratic equation*; which may be resolved by the following

RULE.

1. "Transport all the terms that involve the unknown "quantity to one side, and the known terms to the o- "ther side of the equation.

2. "If the square of the unknown quantity is multi- "plied by any coefficient, you are to divide all the terms "by that coeffient, that the coefficient of the square of "the unknown quantity may be unit.

3. "Add to both sides the square of half the coeffici- "ent prefixed to the unknown quantity itself, and the "side of the equation that involves the unknown quan- "tity will then be a compleat square.

4. "Extract the square root from both sides of the "equation; which you will find, on one side, always to "be the unknown quantity, with half the foresaid coef- "ficient subjoined to it; so that, by transposing this "half, you may obtain the value of the unknown quan- "tity expressed in known terms." Thus,

Suppose $y^2+ay=b$

Add the square of $\frac{a}{2}$ to both sides . . . $\Big\}\; y^2+ay+\frac{a^2}{4}=b+\frac{a^2}{4}$

Extract the root, $y+\frac{a}{2}=\pm\sqrt{b+\frac{a^2}{4}}$

Transpose $\frac{a}{2}$, $y=\pm\sqrt{b+\frac{a^2}{4}}-\frac{a}{2}$.

The square root of any quantity, as $+aa$, may be $+a$, or $-a$; and hence, "All quadratic equations admit of two solutions." In the last example, after finding that $y^2+ay+\frac{a^2}{4}=b+\frac{a^2}{4}$, it may be inferred that $y+\frac{a}{2}$ $=+\sqrt{b+\frac{a^2}{4}}$ or to $-\sqrt{b+\frac{a^2}{4}}$; since $-\sqrt{b+\frac{a^2}{4}}\times-\sqrt{b+\frac{a^2}{4}}$ gives $b+\frac{a^2}{4}$, as well as $+\sqrt{b+\frac{a^2}{4}}\times+\sqrt{b+\frac{a^2}{4}}$. There are therefore two values of y; the one gives $y=+\sqrt{b+\frac{a^2}{4}}-\frac{a}{2}$, the other, $y=-\sqrt{b+\frac{a^2}{4}}-\frac{a}{2}$.

Since the squares of all quantities are positive, it is plain that "the square root of a negative quantity is imaginary, and cannot be assigned." Therefore there are some quadratic equations that cannot have any solution. For example, suppose

$$y^2-ay+3a^2=0$$

then $y^2-ay=-3a^2$

add $\frac{a^2}{4}$ to both, $y^2-ay+\frac{a^2}{4}=-3a^2+\frac{a^2}{4}=$ $=\frac{11a^2}{4}$

extract the root, $y-\frac{a}{2}=\pm\sqrt{-\frac{11a^2}{4}}$

and $y=\frac{a}{2}\pm\sqrt{-\frac{11a^2}{4}}$.

whence the two values of y must be imaginary or impossible, because the root of $-\frac{11a^2}{4}$ cannot possibly be assigned.

Suppose that the quadratic equation proposed to be resolved is $y^2-ay=b$

then $y^2-ay+\frac{a^2}{4}=b+\frac{a^2}{4}$

$y-\frac{a}{2}=\pm\sqrt{b+\frac{a^2}{4}}$

and $y=\frac{a}{2}\pm\sqrt{b+\frac{a^2}{4}}$. If the square root of $b+\frac{a^2}{4}$ cannot be extracted exactly, you must, in order to determine the value of y, nearly approximate to the value of $\sqrt{b+\frac{a^2}{4}}$, by the rules in *chap.* 7. The following examples will illustrate the rule for quadratic equations.

EXAMP. I. "To find that number which if you "multiply by the product shall be equal to the "square of the same number having 12 added to it."

Call the number y, then

$y^2+12=8y$

transp. $y^2-8y=-12$

add the Sq. of 4, $y^2-8y+16=-12+16=4$

extract the R. $y-4=\pm2$

transp. $y=4\pm2=6$ or 2.

EXAMP. II. "To find a number such, that if you "subtract it from 10, and multiply the remainder by "the number itself, the product shall give 21."

Call it y. Then

$\overline{10-y}\times y=21$

that is, $10y-yy=21$

transp. $y^2-10y=-21$

add the sq. of 5, $y^2-10y+25=-21+25=4$

extract, $y-5=\pm\sqrt{4}=\pm2$

and $y=5\pm2=7$ or 3.

EXAMP. III. "A company dining together in an inn, "find their bill amounts to 175 shillings; two of them "were not allowed to pay, and the rest found that their "shares amounted to 10 *s.* a man more than if all had "paid. *Qu.* How many were in company?"

Suppose their number x; then if all had paid, each man's share would have been $\frac{175}{x}$: but now the share of each person is $\frac{175}{x-2}$, seeing $x-2$ is the number of those that pay. It is therefore, by the question,

$$\frac{175}{x-2}-\frac{175}{x}=10.$$

and $175x-175x+350=10x^2-20x$

that is, $10x^2-20x=350$

and $x^2-2x=35$

add 1 . . $x^2-2x+1=35+1=36$

extr. $\sqrt{\;}$ . . $x-1=\pm6$

$x=1\pm6=7$, or, -5.

It is obvious, that the poſitive value 7 gives the ſolution of the queſtion; the negative value —5 being, in the preſent caſe, uſeleſs.

Any equation of this form $y^2m + aym = b$, where the greateſt index of the unknown quantity y is double to the index of y in the other term, may be reduced to a quadratic $z^2 + az = b$, by putting $y^m = z$, and conſequently $y^2m = z^2$. And this quadratic reſolved as above gives

$$z = -\frac{a}{2} \pm \sqrt{b + \frac{a^2}{4}}.$$

And ſeeing $y^m = z = -\frac{a}{2} \pm \sqrt{b + \frac{a^2}{4}}$, $y = \sqrt[m]{-\frac{a}{2} \pm \sqrt{b + \frac{a^2}{4}}}$.

EXAMP. "The product of two quantities is a, and "the ſum of their ſquares b. *Qu.* The quantities?"

$$\text{Supp.} \begin{cases} xy = a \,.\,.\, \text{or } x = \frac{a}{y} \text{ and } x^2 = \frac{a^2}{y^2} \\ x^2 + y^2 = b \,.\,.\, x^2 = b - y^2 \end{cases}$$

$$\text{whence} \quad b - y^2 = \frac{a^2}{y^2}$$

$$\text{mult. by } y^2 \,.\,.\, by^2 - y^4 = a^2$$

$$\text{tranſp. } y^4 - by^2 = -a^2.$$

Put now $y^2 = z$ .. and conſeq. .. $y^4 = z^2$, and it is

$$z^2 - bz = -a^2$$

$$\text{add } \frac{b^2}{4} \,.\,.\, z^2 - bz + \frac{b^2}{4} = \frac{b^2}{4} - a^2$$

$$\text{ext. } \sqrt{} \,.\,.\, z - \frac{b}{2} = \pm \sqrt{\frac{b^2}{4} - a^2}$$

$$\text{and } z = \frac{b}{2} \pm \sqrt{\frac{b^2}{4} - a^2} \text{ and, ſeeing } y = \sqrt{z},$$

$$y = \pm \sqrt{\frac{b}{2} \pm \sqrt{\frac{b^2}{4} - a^2}}.$$

CHAP. XIII. *Of* SURDS.

IF a leſſer quantity meaſures a greater ſo as to leave no remainder, as $2a$ meaſures $10a$, being found in it five times, it is ſaid to be an *aliquot* part of it, and the greater is ſaid to be a *multiple* of the leſſer. The leſſer quantity in this caſe is the *greateſt common meaſure* of the two quantities: for as it meaſures the greateſt, ſo it alſo meaſures itſelf, and no quantity can meaſure it that is greater than itſelf.

When a third quantity meaſures any two propoſed quantities, as $2a$ meaſures $6a$ and $10a$, it is ſaid to be a *common meaſure* of theſe quantities; and if no greater quantity meaſure them both, it is called their *greateſt common* meaſure.

Thoſe quantities are ſaid to be *commenſurable* which have any common meaſure; but if there can be no quantity found that meaſures them both, they are ſaid to be *incommenſurable*; and if any one quantity be called *rational*, all others that have any common meaſure with it, are alſo called rational: But thoſe that have no common meaſure with it, are called *irrational* quantities.

If any two quantities a and b have any common meaſure x, this quantity x ſhall alſo meaſure their ſum or difference $a \mp b$. Let x be found in a as many times as unit is found in m, ſo that $a = mx$, and in b as many times as unit is found in n, ſo that $b = nx$; then ſhall $a \mp b = mx \mp nx = \overline{m \mp n} \times x$; ſo that x ſhall be found in $a \mp b$, as often as unit is found in $m \mp n$: now ſince m and n are integer numbers, $m \mp n$ muſt be an integer number or unit, and therefore x muſt meaſure $a \mp b$.

It is alſo evident, that if x meaſure any number as a, it muſt meaſure any multiple of that number. If it be found in a as many times as unit is found in m ſo that $a = mx$, then it will be found in any multiple of a, as na, as many times as unit is found in mn; for $na = mnx$.

If two quantities a and b are propoſed, and b meaſure a by the units that are in m (that is, be found in a as many times as unit is found in m) and there be a remainder c, and if x be ſuppoſed to be a common meaſure of a and b, it ſhall be alſo a meaſure of c. For by the ſuppoſition $a = mb + c$, ſince it contains b as many times as there are units in m, and there is c beſides of remainder. Therefore $a - mb = c$. Now x is ſuppoſed to meaſure a and b, and therefore it meaſures mb, and conſequently $a - mb$, which is equal to c

If c meaſure b by the units in n, and there be a remainder d, ſo that $b = nc + d$, and $b - nc = d$, then ſhall x alſo meaſure d; becauſe it is ſuppoſed to meaſure b, and it has been proved that it meaſures c, and conſequently nc, and $b - nc$ which is equal to d. Whence, as, after ſubtracting b as often as poſſible from a, the remainder c is meaſured by x; and, after ſubtracting c as often as poſſible from b, the remainder d is alſo meaſured by x; ſo, for the ſame reaſon, if you ſubtract d as often as poſſible from c, the remainder (if there be any) muſt ſtill be meaſured by x: and if you proceed, ſtill ſubtracting every remainder from the preceding remainder, till you find ſome remainder, which, ſubtracted from the preceding, leaves no further remainder, but exactly meaſures it, this laſt remainder will ſtill be meaſured by x, any common meaſure of a and b.

The laſt of theſe remainders, *viz.* that which exactly meaſures the preceding remainder, muſt be a common meaſure of a and b: ſuppoſe that d was this laſt remainder, and that it meaſured c by the units in r, then ſhall $c = rd$, and we ſhall have theſe equations,

$$a = mb + c$$
$$b = nc + d$$
$$c = rd.$$

Now it is plain that ſince d meaſures c, it muſt alſo meaſure nc, and therefore muſt meaſure $nc + d$, or b. And ſince it meaſures b and c, it muſt meaſure $mb + c$, or a; ſo that it muſt be a common meaſure of a and b. But further, it muſt be their *greateſt* common meaſure; for every common meaſure of a and b muſt meaſure d, by the laſt article; and the greateſt number that meaſures d, is itſelf, which therefore is the greateſt common meaſure of a and b.

But if, by continually ſubtracting every remainder from the preceding remainder, you can never find one that meaſures that which precedes it exactly, no quantity can be

be found that will measure both a and b; and therefore they will be *incommensurable* to each other.

For if there was any common measure of these quantities, as x, it would necessarily measure all the remainders c, d, &c. For it would measure $a-mb$, or c, and consequently $b-nc$, or d, and so on; now these remainders decrease in such a manner, that they will necessarily become at length less than x, or any assignable quantity. For c must be less than $\frac{1}{2}a$; because c is less than b, and therefore less than mb, and consequently less than $\frac{1}{2}c+\frac{1}{2}mb$, or $\frac{1}{2}a$. In like manner d must be less than $\frac{1}{2}b$; for d is less than c, and consequently less than $\frac{1}{2}d+\frac{1}{2}nc$, or $\frac{1}{2}b$. The third remainder, in the same manner, must be less than $\frac{1}{2}c$, which is itself less than $\frac{1}{2}a$: Thus these remainders decrease, so that every one is less than the half of that which preceded it next but one. Now if from any quantity you take away more than its half, and from the remainder more than its half, and proceed in this manner, you will come at a remainder less than any assignable quantity. It appears therefore, that if the remainders c, d, &c. never end, they will become less than any assignable quantity, as x, which therefore cannot possibly measure them, and therefore cannot be a common measure of a and b.

In the same way the greatest common measure of two numbers is discovered. Unit is a common measure of all integer numbers, and two numbers are said to be *prime* to each other when they have no greater common measure than unit; such as 9 and 25. Such always are the least numbers that can be assumed in any given proportion; for if these had any common measure, then the quotients that would arise by dividing them by that common measure would be in the same proportion, and, being less than the numbers themselves, these numbers would not be the least in the same proportion; against the supposition.

The least numbers in any proportion always measure any other numbers that are in the same proportion. Suppose a and b to be the least of all integer numbers in the same proportion, and that c and d are other numbers in that proportion, then will a measure c, and b measure d.

For if a and b are not aliquot parts of c and d, then they must contain the same number of the same kind of parts of c and d; and therefore dividing a into parts of c, and b into an equal number of like parts of d, and calling one of the first m, and one of the latter n; then as m is to n, so will the sum of all the m's be to the sum of all the n's; that is, $m:n::a:b$, therefore a and b will not be the least in the same proportion; against the supposition. Therefore a and b must be aliquot parts of c and d. Hence we see that numbers which are prime to each other are the least in the same proportion; for if there were others in the same proportion less than them, these would measure them by the same number, which therefore would be their common measure against the supposition, for we supposed them to be prime to each other.

If two numbers a and b are prime to one another, and a third number c measures one of them a, it will be prime to the other b. For if c and b were not prime to each other, they would have a common measure, which, because it would measure c, would also measure a, which is measured by c, therefore a and b would have a common measure, against the supposition.

If two numbers a and b are prime to c, then shall their product ab be also prime to c: For if you suppose them to have any common measure as d, and suppose that d measures ab by the units in e, so that $de=ab$, then shall $d:a::b:e$. But since d measures c, and c is supposed to be prime to a, it follows that d and a are prime to each other; and therefore d must measure b; and yet, since d is supposed to measure c which is prime to b, it follows that d is also prime to b; that is, d is prime to a number which it measures, which is absurd.

It follows from the last article, that if a and c are prime to each other, then a^2 will be prime to c: For by supposing that a is equal to b, then ab will be equal to a^2; and consequently a^2 will be prime to c. In the same manner c^2 will be prime to a.

If two numbers a and b are both prime to other two c, d, then shall the product ab be prime to the product cd; for ab will be prime to c and also to d, and therefore, by the same article, cd will be prime to ab.

From this it follows, that if a and c are prime to each other, then shall a^2 be prime to c^2, by supposing, in the last, that $a=b$, and $c=d$. It is also evident that a^3 will be prime to c^3, and in general any power of a to any power of c whatsoever.

Any two numbers, a and b, being given, to find the least numbers that are in the same proportion with them, *divide them by their greatest common measure* x, and *the quotients* c *and* d *shall be the least numbers in the same proportion with* a *and* b.

For if there could be any other numbers in that proportion less than c and d, suppose them to be e and f, and these being in the same proportion as a and b would measure them: And the number by which they would measure them, would be greater than x, because e and f are supposed less than c and d, so that x would not be the greatest common measure of a and b; against the supposition.

Let it be required to find the least number that any two given numbers, as a and b, can measure. First, "If they are prime to each other, then their product ab is the least number which they can both measure."

For if they could measure a less number than ab as c, suppose that c is equal to ma, and to nb; and since c is less than ab, therefore ma will be less than ab, and m less than b; and nb being less than ab, it follows that n must be less than a; but since $ma=nb$, and consequently $a:b::n:m$, and a and b are prime to each other, it would follow that a would measure n, and b measure m, that is, a greater number would measure a less, which is absurd.

But if the numbers a and b are not prime to each other, and their greatest common measure is x, which measures a by the units in m, and measures b by the units in n, so that $a=mx$, and $b=nx$, then shall an (which is equal to bm, because $a:b::mx:nx::m:n$, and therefore $an=bm$) be the least number that a and b can both measure. For if they could measure any number c less than

than na, so that $c=la=kb$, then $a : b :: m : n :: k : l$; and because x is supposed to be the greatest common measure of a and b, it follows that m and n are the least of all numbers in the same proportion, and therefore m measures k, and n measures l. But as c is supposed to be less than na, that is, la less than na, therefore l is less than n, so that a greater would measure a lesser, which is absurd. Therefore a and b cannot measure any number less than an; which they both measure, because $na=mb$.

It follows from this reasoning, that if a and b measure any quantity c, the least quantity na, which is measured by a and b, will also measure c. For if you suppose, as before, that $c=la$, you will find, that n must measure l, and na must measure la or c.

Let a express any integer number, and $\frac{m}{n}$ any fraction reduced to its lowest terms, so that m and n may be prime to each other, and consequently $an+m$ also prime to n, it will follow that $\overline{an+m}^2$ will be prime to n^2, and consequently $\frac{\overline{an+m}^2}{n^2}$ will be a fraction in its least terms, and can never be equal to an integer number. Therefore the square of the mixt number $a+\frac{m}{n}$ is still a mixt number, and never an integer. In the same manner, the cube, biquadrate, or any power of a mixt number, is still a mixt number, and never an integer. It follows from this, that *the square root of an integer must be an integer or an incommensurable.* Suppose that the integer proposed is B, and that the square root of it is less than $a+1$, but greater than a, then it must be an incommensurable; for if it is a commensurable, let it be $a+\frac{m}{n}$ where $\frac{m}{n}$ represents any fraction reduced to its least terms; it would follow, that $a+\frac{m}{n}$ squared would give an integer number B, the contrary of which we have demonstrated.

It follows from the last article, that *the square roots of all numbers but of* 1, 4, 9, 16, 25, 36, 49, 64, 81, 100, 121, 144, &c. (which are the squares of the integer numbers 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, &c.) *are incommensurables*: after the same manner, *the cube roots of all numbers but of the cubes of* 1, 2, 3, 4, 5, 6, 7, 8, 9, &c. *are incommensurables*; and quantities that are to one another in the proportion of such numbers must also have their square roots or cube roots incommensurable.

The roots of such numbers being incommensurable are expressed therefore by placing the proper radical sign over them; thus, $\sqrt[2]{2}$, $\sqrt[2]{3}$, $\sqrt[2]{5}$, $\sqrt[2]{6}$, $\sqrt{7}$, $\sqrt{8}$, $\sqrt{10}$, &c. express numbers incommensurable with unit. These numbers, though they are incommensurable themselves with unit, are *commensurable in power* with it, because their powers are integers, that is, multiples of unit. They may also be commensurable sometimes with one another, as the $\sqrt[2]{8}$, and the $\sqrt[2]{2}$, because they are to one another as 2 to 1: And when they have a common measure, as $\sqrt[2]{2}$ is the common measure of both, then their ratio is reduced to an expression in the least terms, as that of commensurable quantities, by dividing them by their greatest common measure. This common measure is found as in commensurable quantities, only the root of the common measure is to be made their common divisor. Thus, $\frac{\sqrt{12}}{\sqrt{3}}=\sqrt{4}=2$, and $\frac{\sqrt{18a}}{\sqrt{2}}=3\sqrt{a}$.

A rational quantity may be reduced to the form of any given surd, by raising the quantity to the power that is denominated by the name of the surd, and then setting the radical sign over it thus, $a=\sqrt[2]{a^2}=\sqrt[3]{a^3}=\sqrt[4]{a^4}=\sqrt[5]{a^5}=\sqrt[n]{a^n}$, and $4=\sqrt{16}=\sqrt[3]{64}=\sqrt[4]{256}=\sqrt[5]{1024}=\sqrt[n]{4^n}$.

As surds may be considered as powers with fractional exponents, "they are reduced to others of the same value that shall have the same radical sign, by reducing these fractional exponents to fractions having the same value and a common denominator." Thus, $\sqrt[n]{a}=a^{\frac{1}{n}}$, $\sqrt[m]{a}=a^{\frac{1}{m}}$, and $\frac{1}{n}=\frac{m}{nm}$, $\frac{1}{m}=\frac{n}{nm}$, and therefore $\sqrt[n]{a}$ and $\sqrt[m]{a}$, reduced to the same radical sign, become $\sqrt[nm]{a^m}$ and $\sqrt[nm]{a^n}$. If you are to reduce $\sqrt[2]{3}$ and $\sqrt[3]{2}$ to the same denominator, consider, $\sqrt[2]{3}$ as equal to $3^{\frac{1}{2}}$, the $\sqrt[3]{2}$ as equal to $2^{\frac{1}{3}}$, whose indices reduced to a common denominator, you have $3^{\frac{1}{2}}=3^{\frac{3}{6}}$ and $2^{\frac{1}{3}}=2^{\frac{2}{6}}$, and consequently $\sqrt[2]{3}=\sqrt[6]{3^3}=\sqrt[6]{27}$, and $\sqrt[3]{2}=\sqrt[6]{2^2}=\sqrt[6]{4}$; so that the proposed surds $\sqrt[2]{3}$ and $\sqrt[3]{2}$ are reduced to other equal surds $\sqrt[6]{27}$ and $\sqrt[6]{4}$, having a common radical sign.

Surds of the same rational quantity are multiplied by adding their exponents, and divided by subtracting them; thus $\sqrt[2]{a}\times\sqrt[3]{a}=a^{\frac{1}{2}}\times a^{\frac{1}{3}}=a^{\frac{3+2}{6}}=a^{\frac{5}{6}}=\sqrt[6]{a^5}$; and $\frac{\sqrt[3]{a}}{\sqrt[5]{a}}=\frac{a^{\frac{1}{3}}}{a^{\frac{1}{5}}}=a^{\frac{1}{3}-\frac{1}{5}}=a^{\frac{5-3}{15}}=a^{\frac{2}{15}}=\sqrt[15]{a^2}$;

$\sqrt[m]{a}\times\sqrt[n]{a}=a^{\frac{m+n}{mn}}$; $\frac{\sqrt[m]{a}}{\sqrt[n]{a}}=a^{\frac{n-m}{mn}}$; $\sqrt[2]{2}\times\sqrt[3]{2}=\sqrt[6]{2^5}=\sqrt[6]{32}$; $\frac{\sqrt[2]{2}}{\sqrt[3]{2}}=\sqrt[6]{2}$.

If the surds are of different rational quantities, as $\sqrt[n]{a^2}$ and $\sqrt[n]{b^3}$, and have the same sign, "multiply these rational quantities into one another, or divide "them

"them by one another; and set the common radical sign "over their product or quotient." Thus, $\sqrt[n]{a^2}\times\sqrt[n]{b^3}=\sqrt[n]{a^2b^3}$; $\sqrt[2]{2}\times\sqrt[2]{5}=\sqrt[2]{10}$; $\frac{\sqrt[m]{a^4}}{\sqrt[m]{b^3a}}=\sqrt[m]{\frac{a^4}{b^3a}}=\sqrt[m]{\frac{a^3}{b^3}}$;

If the surds have not the same radical sign, "reduce "them to such as shall have the same radical sign, and "proceed as before," $\sqrt[m]{a}\times\sqrt[n]{b}=\sqrt[nm]{a^nb^m}$; $\frac{\sqrt[m]{a}}{\sqrt[n]{x}}=\sqrt[mn]{\frac{a^n}{x^m}}$; $\sqrt[2]{2}\times\sqrt[3]{4}=2^{\frac{1}{2}}\times4^{\frac{1}{3}}=2^{\frac{3}{6}}\times4^{\frac{2}{6}}=\sqrt[6]{2^3\times4^2}=\sqrt[6]{8\times16}=\sqrt[6]{128}$. If the surds have any rational coefficients, their product or quotient must be prefixed; thus, $2\sqrt[2]{3}\times5\sqrt[2]{6}=10\sqrt[2]{18}$.

The powers of surds are found as the powers of other quantities, "by multiplying their exponents by the in- "dex of the power required;" thus the square of $\sqrt[3]{2}$ is $2^{\frac{1}{3}\times2}=2^{\frac{2}{3}}=\sqrt[3]{4}$; the cube of $\sqrt[2]{5}=5^{\frac{1}{2}\times3}=5^{\frac{3}{2}}=\sqrt[2]{125}$. Or you need only, in involving surds, "raise the quan- "tity under the radical sign to the power required, con- "tinuing the same radical sign; unless the index of that "power is equal to the name of the surd, or a multiple "of it, and in that case the power of the surd becomes "rational." Evolution is performed "by dividing the "fraction which is the exponent of the surd by the "name of the root required." Thus the square root of $\sqrt[3]{a^4}$ is $\sqrt[3]{a^2}$ or $\sqrt[6]{a^4}$.

The surd $\sqrt[m]{a^mx}=a\sqrt[m]{x}$; and in like manner, if a power of any quantity of the same name with the surd divides the quantity under the radical sign without a remainder, as here a^m divides a^mx, and 25 the square of 5 divides 75 the quantity under the sign in $\sqrt[2]{75}$ without a remainder, then place the root of that power rationally before the sign, and the quotient under the sign, and thus the surd will be reduced to a more simple expression. Thus, $\sqrt[2]{75}=5\sqrt{3}$; $\sqrt[2]{48}=\sqrt[2]{3\times16}=4\sqrt{3}$; $\sqrt[3]{81}=\sqrt[3]{27\times3}=3\sqrt[3]{3}$.

When surds by the last article are reduced to their least expressions, if they have the same irrational part, they are added or subtracted, "by adding or subtracting "their rational coefficients, and prefixing the sum or "difference to the common irrational part." Thus, $\sqrt[2]{75}+\sqrt[2]{48}=5\sqrt{3}+4\sqrt{3}=9\sqrt{3}$; $\sqrt[3]{81}+\sqrt[3]{24}=3\sqrt[3]{3}+2\sqrt[3]{3}=5\sqrt[3]{3}$.

Compound surds are such as consist of two or more joined together. The simple surds are commensurable in power, and by being multiplied into themselves give at length rational quantities; yet compound surds multiplied into themselves commonly give still irrational products. But when any compound surd is proposed, *there is another compound surd which multiplied into it gives a rational product.* Thus, $\sqrt{a}+\sqrt{b}$ multiplied by $\sqrt{a}-\sqrt{b}$ gives $a-b$, and "the investigation of that surd "which multiplied into the proposed surd will give a "rational product," is made easy by the following theorems.

THEOREM I.

Generally, if you multiply a^m-b^m by $a^{n-m}+a^{n-2m}b^m+a^{n-3m}b^{2m}+a^{n-4m}b^{3m}$, &c. continued till the terms be in number equal to $\frac{n}{m}$, the product shall be a^n-b^n; for

$$\begin{array}{l}
a^{n-m}+a^{n-2m}b^m+a^{n-3m}b^{2m}+a^{n-4m}b^{3m}, \text{ \&c.} \ldots b^{n-m} \\
\times a^m-b^m \\
\hline
a^n+a^{n-m}b^m+a^{n-2m}b^{2m}+a^{n-3m}b^{3m}, \text{ \&c.} \\
\quad -a^{n-m}b^m-a^{n-2m}b^{2m}-a^{n-3m}b^{3m}, \text{ \&c.}-b^n \\
\hline
a^n \quad * \quad * \quad * \quad -b^n.
\end{array}$$

THEOREM II.

$a^{n-m}-a^{n-2m}b^m+a^{n-3m}b^{2m}-a^{n-4m}b^{3m}$, &c. multiplied by a^m+b^m gives $a^n\mp b^n$, which is demonstrated as the other. Here the sign of b^n is positive, when $\frac{n}{m}$ is an odd number.

When any binomial surd is proposed, "suppose the "index of each number equal to m, and let n be the "least integer number that is measured by m, then shall "$a^{n-m}\mp a^{n-2m}b^m+a^{n-3m}b^{2m}$, &c. give a compound "surd, which multiplied into the proposed surd $a^m\pm b^m$ "will give a rational product." Thus to find the surd which multiplied by $\sqrt[3]{a}-\sqrt[3]{b}$, will give a rational quantity. Here $m=\frac{1}{3}$, and the least number which is measured by $\frac{1}{3}$ is unit; let $n=1$, then shall $a^{n-m}+a^{n-2m}b^m+a^{n-3m}b^{2m}$, &c. $=a^{1-\frac{1}{3}}+a^{1-\frac{2}{3}}b^{\frac{1}{3}}+a^0b^{\frac{2}{3}}=a^{\frac{2}{3}}+a^{\frac{1}{3}}b^{\frac{1}{3}}+b^{\frac{2}{3}}=\sqrt[3]{a^2}+\sqrt[3]{ab}+\sqrt[3]{b^2}$, which multiplied by $\sqrt[3]{a}-\sqrt[3]{b}$ gives $a-b$.

To find the surd which multiplied by $\sqrt[4]{a^3}+\sqrt[4]{b^3}=a^{\frac{3}{4}}+b^{\frac{3}{4}}$, gives a rational product. Here $m=\frac{3}{4}$ and $n=3$, and $a^{n-m}-a^{n-2m}b^m+a^{n-3m}b^{2m}$, &c. $=a^{3-\frac{3}{4}}-a^{3-\frac{6}{4}}b^{\frac{3}{4}}+a^{3-\frac{9}{4}}b^{\frac{3}{2}}-a^{3-3}b^{\frac{9}{4}}=a^{\frac{9}{4}}-a^{\frac{6}{4}}b^{\frac{3}{4}}+a^{\frac{3}{4}}b^{\frac{6}{4}}-b^{\frac{9}{4}}=\sqrt[4]{a^9}-\sqrt[4]{a^6b^3}+\sqrt[4]{a^3b^6}-\sqrt[4]{b^9}$.

THEOREM III.

Let $a^m\pm b^l$ be multiplied by $a^{n-m}\mp a^{n-2m}b^l+a^{n-3m}b^{2l}\mp a^{n-4m}b^{3l}$, and the product shall give $a^n\pm b^{\frac{nl}{m}}$: "therefore n must be taken the least integer that shall "give $\frac{nl}{m}$ also an integer.

Dem.

Dem. $a^{n-m} \mp a^{n-2m}b^{l} + a^{n-3m}b^{2l} \mp a^{n-4m}b^{3l} \ldots \overline{\frac{n}{l}-1} \times l$

$\times a^{m} \pm b^{l} \qquad \ldots . \&c. \; a^{0}b^{m}$

$a^{n} \mp a^{n-m}b^{l} + a^{n-2m}b^{2l}, \; \&c.$

$\pm a^{n-m}b^{l} - a^{n-2m}b^{2l} \; \& \pm b^{m\overline{\frac{n}{l}-l}}$

$a^{n} \quad * \quad * \quad * \quad \pm b^{m\overline{\frac{n}{l}-l}}$

The sign of $b^{\frac{nl}{m}}$ is positive only when $\frac{n}{m}$ is an odd number, and the binomial proposed is $a^{m}+b^{l}$.

If any binomial surd is proposed whose two numbers have different indices, let these be m and l, and take n equal to the least integer number that is measured by m and by $\frac{m}{l}$; and $a^{n-m} \mp a^{n-2m}b^{l} + a^{n-3m}b^{2l} \mp a^{n-4m}b^{3l}$, &c. shall give a compound surd, which multiplied by the proposed $a^{m} \pm b^{l}$ shall give a rational product. Thus $\sqrt[2]{a} - \sqrt[3]{b}$ being given, suppose $m=\frac{1}{2}$, $l=\frac{1}{3}$, and $\frac{m}{l}=\frac{3}{2}$, therefore you have $n=3$, and $a^{n-m}+a^{n-2m}b^{l}+a^{n-3m}b^{2l}+a^{n-4m}b^{3l}+$ &c. $=a^{3-\frac{1}{2}}+a^{3-1}b^{\frac{1}{3}}+a^{3-\frac{3}{2}}b^{\frac{2}{3}}+a^{3-2}b+a^{3-\frac{5}{2}}b^{\frac{4}{3}}+a^{0}b^{\frac{5}{3}}=a^{\frac{5}{2}}+a^{2}b^{\frac{1}{3}}+a^{\frac{3}{2}}b^{\frac{2}{3}}+ab+a^{\frac{1}{2}}b^{\frac{4}{3}}+b^{\frac{5}{3}}=\sqrt{a^{5}}+a^{2}\times\sqrt[3]{b}+\sqrt[2]{a^{3}}\times\sqrt[3]{b^{2}}+ab+\sqrt[2]{a}\times\sqrt[3]{b^{4}}+\sqrt[2]{b^{5}}=a^{2}\sqrt{a}+a^{2}\times\sqrt[3]{b}+a\sqrt{a}\times\sqrt[3]{b^{2}}+ab+b\sqrt{a}\times\sqrt[3]{b}+b\times\sqrt[3]{b^{2}}$, which multiplied by the $\sqrt[2]{a}-\sqrt[3]{b}$ gives $a^{n}-b^{\frac{nl}{m}}=a^{3}-b^{2}$.

By these theorems any binomial surd whatsoever being given, you may find a surd which multiplied by it shall give a rational product.

Suppose that a binomial surd was to be divided by another, as $\sqrt[2]{20}+\sqrt[2]{12}$, by $\sqrt[2]{5}-\sqrt[2]{3}$, the quotient may be expressed by $\frac{\sqrt{20}+\sqrt{12}}{\sqrt{5}-\sqrt{3}}$. But it may be expressed in a more simple form by *multiplying both numerator and denominator by that surd which, multiplied into the denominator, gives a rational product*: Thus $\frac{\sqrt{20}+\sqrt{12}}{\sqrt{5}-\sqrt{3}}=\frac{\sqrt{20}+\sqrt{12}}{\sqrt{5}-\sqrt{3}}\times\frac{\sqrt{5}+\sqrt{3}}{\sqrt{5}+\sqrt{3}}=\frac{\sqrt{100}+2\sqrt{60}+6}{5-3}=\frac{16+2\sqrt{60}}{2}=8+2\sqrt{15}$.

In general, when any quantity is divided by a binomial surd, as $a^{m}\pm b^{l}$, where m and l represent any fractions whatsoever, *take* n *the least integer number that is measured by* m *and* $\frac{\mathrm{m}}{\mathrm{l}}$, *multiply both numerator and denominator by* $\mathrm{a}^{\mathrm{n}-\mathrm{m}}+\mathrm{a}^{\mathrm{n}-2\mathrm{m}}\mathrm{b}^{\mathrm{l}}+\mathrm{a}^{\mathrm{n}-3\mathrm{m}}\mathrm{b}^{2\mathrm{l}}$, &c. *and the denominator of the product will become rational, and equal to* $\mathrm{a}^{\mathrm{n}}-\mathrm{b}^{\frac{\mathrm{nl}}{\mathrm{m}}}$; *then divide all the members of the numerator by this rational quantity, and the quote arising will be that of the proposed quantity divided by the binomial surd, expressed in its least terms.* Thus,

$$\frac{3}{\sqrt{5}-\sqrt{2}}=\frac{3\sqrt{5}+3\sqrt{2}}{3}=\sqrt{5}+\sqrt{2};$$
$$\frac{\sqrt{6}}{\sqrt{7}-\sqrt{3}}=\frac{\sqrt{42}+\sqrt{18}}{4}.$$

When the square root of a surd is required, it may be found nearly *by extracting the root of a rational quantity that approximates to its value*. Thus to find the square root of $3+2\sqrt{2}$, we first calculate $\sqrt{2}=1,41421$; and therefore $3+2\sqrt{2}=5,82842$, whose root is found to be nearly $2,41421$: So that $\sqrt[2]{3+2\sqrt{2}}$ is nearly $2,41421$. But sometimes we may be able to express the roots of surds exactly by other surds; as in this example the square root of $3+2\sqrt{2}$ is $\overline{1+\sqrt{2}}$, for $\overline{1+\sqrt{2}}\times\overline{1+\sqrt{2}}=1+2\sqrt{2}+2=3+2\sqrt{2}$.

In order to know when and how this may be found, let us suppose that $x+y$ is a binomial surd, whose square will be $x^{2}+y^{2}+2xy$: If x and y are quadratic surds, then $x^{2}+y^{2}$ will be rational, and $2xy$ irrational; so that $2xy$ shall always be less than $x^{2}+y^{2}$, because the difference is $x^{2}+y^{2}-2xy=\overline{x-y}^{2}$ which is always positive. Suppose that a proposed surd consisting of a rational part A, and an irrational part B, coincides with this, then $x^{2}+y^{2}=A$ and $xy=\frac{1}{2}B$: Therefore by what was said of equations, Chap. 12th,

$$y^{2}=A-x^{2}=\frac{B^{2}}{4x^{2}}, \text{ and therefore,}$$

$$Ax^{2}-x^{4}=\frac{B^{2}}{4} \text{ and } x^{4}-Ax^{2}+\frac{B^{2}}{4}=0;$$

from whence we have $x^{2}=\frac{A+\sqrt{A^{2}-B^{2}}}{2}$ and $y^{2}=\frac{A-\sqrt{A^{2}-B^{2}}}{2}$. Therefore when a quantity partly rational, partly irrational, is proposed to have its root extracted, *call the rational part* A, *the irrational* B, *and the square of the greatest member of the root shall be* $\frac{A+\sqrt{A^{2}-B^{2}}}{2}$, *and the square of the lesser part shall be* $\frac{A-\sqrt{A^{2}-B^{2}}}{2}$. And as often as the square root of $A^{2}-B^{2}$ can be extracted, the square root of the proposed binomial surd may be expressed itself as a binomial surd. For example, if $3+2\sqrt{2}$ is proposed, then $A=3$, $B=2\sqrt{2}$ and $A^{2}-B^{2}=9-8=1$. Therefore $x^{2}=\frac{A+\sqrt{A^{2}-B^{2}}}{2}=2$, and $y^{2}=\frac{A-\sqrt{A^{2}-B^{2}}}{2}=1$. Therefore $x+y=1+\sqrt{2}$.

To find the square root of $-1+\sqrt{-8}$, suppose $A=-1$, $B=\sqrt{-8}$, so that $A^{2}-B^{2}=9$ and $\frac{A+\sqrt{A^{2}-B^{2}}}{2}=\frac{-1+3}{2}=1$, and $\frac{A-\sqrt{A^{2}-B^{2}}}{2}=\frac{-1-3}{2}=-2$, therefore the root required is $1+\sqrt{-2}$.

But

But though x and y are not quadratic furds or roots of integers, if they are the roots of like furds, as if they are equal to $\sqrt{m\sqrt{z}}$ and $\sqrt{n\sqrt{z}}$, where m and n are integers, then $A=\overline{m+n}\times\sqrt{z}$ and $\frac{1}{2}B=\sqrt[2]{mnz}$; $A^2-B^2=\overline{m-n}|^2\times z$ and $x^2=\frac{A+\sqrt{A^2-B^2}}{2}=\frac{\overline{m+n}\times z+\overline{m-n}|^2\times z}{2}=m\sqrt{z}$, $y^2=\frac{A-\sqrt{A^2-B^2}}{2}=n\sqrt{z}$, and $x+y=\sqrt{m\sqrt{z}}+\sqrt{n\sqrt{z}}$. The part A here eafily diftinguifhes itfelf from B by its being greater.

If x and y are equal to $\sqrt{m\sqrt{z}}$ and $\sqrt{n\sqrt{t}}$, then $x^2+2xy+y^2=m\sqrt{z}+n\sqrt{t}+2\sqrt{mn\sqrt{zt}}$. So that if z or t be not multiples one of the other, or of fome number that meafures them both by a fquare number, then will A itfelf be a binomial.

Let $x+y+z$ exprefs any trinomial furd, its fquare $x^2+y^2+z^2+2xy+2xz+2yz$ may be fuppofed equal to $A+B$ as before. But rather multiply any two radicals as $2xy$ by $2xz$, and divide by the third $2yz$ which gives the quotient $2x^2$ rational, and double the fquare of the furd x required. The fame rule ferves when there are four quantities $\overline{x^2+y^2+z^2+s^2}+2xy+2xs+2xz+2yz+2ys+2zs$; multiply $2xy$ by $2xs$, and the product $4x^2sy$ divided by $2sy$ gives $2x^2$ a rational quotient, half the fquare of $2x$. In like manner $2xy\times 2yz=4y^2xz$, which divided by $2xz$ another member gives $2y^2$, a rational quote, the half of the fquare of $2y$. In the fame manner z and s may be found; and their fum $x+y+z+s$, the fquare root of the feptinomial $\overline{x^2+y^2+z^2+s^2}+2xy+2xs+2xz+2yz+2ys$, difcovered.

For example, to find the fquare root of $10+\sqrt{24}+\sqrt{40}+\sqrt{60}$; I try $\frac{\sqrt{24}\times\sqrt{40}}{\sqrt{60}}$ which I find to be $\sqrt{16}=4$, the half of the fquare root of the double of which, *viz.* $\frac{1}{2}\times\sqrt{8}=\sqrt{2}$, is one member of the fquare root required; next $\frac{\sqrt{24}\times\sqrt{60}}{\sqrt{40}}=6$, the half of the fquare root of the double of which is $\sqrt{3}$ another member of the root required; laftly, $\frac{\sqrt{40}\times\sqrt{60}}{\sqrt{24}}=10$, which gives $\sqrt{5}$ for the third member of the root required: from which we conclude, that the fquare root of $10+\sqrt{24}+\sqrt{40}+60$. is $\sqrt{2}+\sqrt{3}+\sqrt{5}$; and trying, you find it fucceeds, fince multiplied by itfelf it gives the propofed quadrinomial.

For extracting the higher roots of a binomial, whofe two members being fquared are commenfurable numbers, there is the following

Rule. "Let the quantity be $A\pm B$, whereof A is "the greater part, and c the exponent of the root "required. Seek the leaft number n whofe power "n^c is divifible by $AA-BB$, the quotient being Q. "Compute $\sqrt[c]{\overline{A+B}\times\sqrt{Q}}$ in the neareft integer "number, which fuppofe to be r. Divide $A\sqrt{Q}$ by "its greateft rational divifor, and let the quotient be s, "and let $\frac{r+\frac{n}{r}}{2s}$ in the neareft integer number, be "t, fo fhall the root required be $\frac{ts\pm\sqrt{t^2s^2-n}}{\sqrt[2c]{Q}}$, if "the c root of $A\pm B$ can be extracted.

Examp. I. Thus to find the cube root of $\sqrt{968}+25$, we have $A^2-B^2=343$, whofe divifors are 7, 7, 7, whence $n=7$, and $Q=1$. Further, $\overline{A+B}\times\sqrt{Q}$. that is, $\sqrt{968}+25$ is a little more than 56, whofe neareft cube root is 4. Wherefore $r=4$. Again, dividing $\sqrt{968}$ by its greateft rational divifor, we have $A\sqrt{Q}=22\sqrt{2}$, and the radical part $\sqrt{2}=s$; and $\frac{r+\frac{n}{r}}{2s}$; or $\frac{5}{2\sqrt{2}}$, in the neareft integers, is $2=t$. And laftly, $ts=2\sqrt{2}$, $\sqrt{t^2s^2-n}=1$, and $\sqrt[2c]{Q}=\sqrt[6]{1}=1$. Whence $2\sqrt{2}+1$ is the root, whofe cube, upon trial, I find to be $\sqrt{968}+25$.

Examp. II. To find the cube root of $68-\sqrt{4374}$, we have $A^2-B^2=250$, whofe divifors are 5, 5, 5, 2. Thence $n=5\times 2=10$, and $Q=4$; and $\sqrt[c]{\overline{A+B}\times\sqrt{Q}}$, or $\sqrt[3]{\overline{68+\sqrt{4374}}\times 2}$ is nearly $7=r$; again $A\sqrt{Q}$, or $68\times\sqrt{4}=136\times\sqrt{1}$, that is, $s=1$, and $\frac{r+\frac{n}{r}}{2s}$, or $\frac{7+\frac{10}{7}}{2}$, is nearly $=4=t$. Therefore $ts=4$, $\sqrt{t^2s^2-n}=\sqrt{6}$, and $\sqrt[2c]{Q}=\sqrt[6]{4}=\sqrt[3]{2}$, whence the root to be tried is $\frac{4-\sqrt{6}}{\sqrt[3]{2}}$.

Chap. XIV. *Of the* Genesis *and* Resolution *of* Equations *in general; and the number of Roots an Equation of any Degree may have.*

After the fame manner, as the higher powers are produced by the multiplication of the lower powers of the fame root, equations of fuperior orders are generated by the multiplication of equations of inferior orders involving the fame unknown quantity. And "an equation of any dimenfion may be confidered as produced "by the multiplication of as many fimple equations as "it has dimenfions, or of any other equations whatfoever, if the fum of their dimenfions is equal to the "dimenfion of that equation." Thus, any *cubic* equation may be conceived as generated by the multiplication of *three* fimple equations, or of *one quadratic* and *one fimple* equation. A *biquadratic* is generated by the multiplication of *four fimple* equations, or of *two quadratic* equations, or, laftly, of *one cubic* and *one fimple* equation.

If the equations which you fuppofe multiplied by one another are *the fame*, then the equation generated will be nothing elfe but fome power of thofe equations, and the operation is merely *involution*; of which we have treated already: and, when any fuch equation is given, the fimple equation by whofe multiplication it is produced is found by *evolution*, or the extraction of a root.

But when the equations that are fuppofed to be multiplied

tiplied by each other are *different*, then other equations than powers are generated; which to reſolve into the ſimple equations whence they are generated is a different operation from involution, and is what is called, *the reſolution of equations*.

But as evolution is performed by obſerving and tracing back the ſteps of involution; ſo to diſcover the rules for the reſolution of equations, we muſt carefully obſerve their *generation*.

Suppoſe the unknown quantity to be x, and its values in any ſimple equations to be a, b, c, d, &c. then thoſe ſimple equations, by bringing all the terms to one ſide, become $x-a=0$, $x-b=0$, $x-c=0$, &c. And, the product of any two of theſe, as $\overline{x-a}\times\overline{x-b}=0$ will give a quadratic equation, or an equation of two dimenſions. The product of any three of them, as $\overline{x-a}\times\overline{x-b}\times\overline{x-c}=0$, will give a *cubic* equation, or one of three dimenſions. The product of any four of them will give a *biquadratic* equation, or one of four dimenſions, as $\overline{x-a}\times\overline{x-b}\times\overline{x-c}\times\overline{x-d}=0$. And, in general, "in the equation produced, the higheſt dimenſion of "the unknown quantity will be equal to the number "of ſimple equations that are multiplied by each o-"ther."

When any equation, equivalent to this biquadratic $\overline{x-a}\times\overline{x-b}\times\overline{x-c}\times\overline{x-d}=0$, is propoſed to be reſolved, the whole difficulty conſiſts in finding the ſimple equations $x-a=0$, $x-b=0$, $x-c=0$, $x-d=0$, by whoſe multiplication it is produced; for each of theſe ſimple equations gives one of the values of x, and one ſolution of the propoſed equation. For, if any of the values of x, deduced from thoſe ſimple equations, be ſubſtituted in the propoſed equation in place of x, then all the terms of that equation will vaniſh, and the whole be found equal to nothing. Becauſe, when it is ſuppoſed that $x=a$, or $x=b$, or $x=c$, or $x=d$, then the product $\overline{x-a}\times\overline{x-b}\times\overline{x-c}\times\overline{x-d}$ does vaniſh, becauſe one of the factors is equal to nothing. There are therefore four ſuppoſitions that give $\overline{x-a}\times\overline{x-b}\times\overline{x-c}\times\overline{x-d}=0$ according to the propoſed equation; that is, there are four roots of the propoſed equation. And after the ſame manner, "any other equation admits of as many "ſolutions as there are ſimple equations multiplied by "one another that produce it, or, as many as there are "units in the higheſt dimenſion of the unknown quanti-"ty in the propoſed equation."

But as there are no other quantities whatſoever beſides theſe four (a, b, c, d,) that ſubſtituted in the product $\overline{x-a}\times\overline{x-b}\times\overline{x-c}\times\overline{x-d}$, in the place of x, will make the product vaniſh; therefore the equation $\overline{x-a}\times\overline{x-b}\times\overline{x-c}\times\overline{x-d}=0$, cannot poſſibly have more than theſe four roots, and cannot admit of more ſolutions than four. If you ſubſtitute in that product a quantity neither equal to a, nor b, nor c, nor d, which ſuppoſe e, then ſince neither $e-a$, $e-b$, $e-c$, nor $e-d$ is equal to nothing; their product $\overline{e-a}\times\overline{e-b}\times\overline{e-c}\times\overline{e-d}$ cannot be equal to nothing, but muſt be ſome real product: and therefore there is no ſuppoſition beſide one of the foreſaid four that gives a juſt value of x according to the propoſed equation. So that it can have no more than theſe four roots. And after the ſame manner it appears, that "no equation can "have more roots than it contains dimenſions of the unknown quantity."

To make all this ſtill plainer by an example, in numbers; ſuppoſe the equation to be reſolved, to be $x^4-10x^3+35x^2-50x+24=0$, and that you diſcover that this equation is the ſame with the product of $\overline{x-1}\times\overline{x-2}\times\overline{x-3}\times\overline{x-4}$, then you certainly infer that the four values of x are 1, 2, 3, 4; ſeeing any of theſe numbers placed for x makes that product, and conſequently $x^4-10x^3+35x^2-50x+24$, equal to nothing, according to the propoſed equation. And it is certain that there can be no other values of x beſides theſe four: ſince when you ſubſtitute any other number for x in thoſe factors $x-1$, $x-2$, $x-3$, $x-4$, none of the factors vaniſh; and therefore their product cannot be equal to nothing, according to the equation.

It may be uſeful ſometimes to conſider equations as generated from others of an inferior ſort beſides ſimple ones. Thus a *cubic* equation may be conceived as generated from the *quadratic* $x^2-px+q=0$, and the *ſimple* equation $x-a=0$, multiplied by each other; whoſe product

$$\left.\begin{matrix} x^3-px^2+qx-aq \\ -ax^2+apx \end{matrix}\right\}=0$$

may expreſs any cubic equation whoſe roots are the quantity (a) the value of x in the ſimple equation, and the two roots of the quadratic equation, *viz.* $\frac{p+\sqrt{p^2-4q}}{2}$ and $\frac{p-\sqrt{p^2-4q}}{2}$; as appears from Chap. 12. And, according as theſe roots are *real* or *impoſſible*, two of the roots of the cubic equation are *real* or *impoſſible*.

In the doctrine of involution, we ſhewed, that "the "ſquare of any quantity, poſitive or negative, is always "poſitive;" and therefore "the ſquare root of a nega-"tive is impoſſible or imaginary." For example, the $\sqrt{a^2}$ is either $+a$, or $-a$; but $\sqrt{-a^2}$ can neither be $+a$ nor $-a$, but muſt be *imaginary*. Hence is underſtood, that "a quadratic equation may have no impoſſible "expreſſion in its coefficients; and yet, when it is re-"ſolved into the ſimple equations that produce it, they "may involve impoſſible expreſſions." Thus, the quadratic equation $x^2+a^2=0$ has no impoſſible coefficient; but the ſimple equations from which it is produced, *viz.* $x+\sqrt{-a^2}=0$, and $x-\sqrt{-a^2}=0$, both involve an imaginary quantity; as the ſquare $-a^2$ is a real quantity, but its ſquare root is imaginary. After the ſame manner, a biquadratic equation, when reſolved, may give four ſimple equations, each of which may give an impoſſible value for the root: and the ſame may be ſaid of any equation that can be produced from quadratic equations only, that is, whoſe dimenſions are of the even numbers.

But, "a cubic equation (which cannot be generated "from quadratic equations only, but requires one ſim-"ple equation beſides to produce it) if none of its coef-"ficients are impoſſible, will have, at leaſt, one real "root," the ſame with the root of the ſimple equation whence

whence it is produced. The ſquare of an impoſſible quantity may be real, as the ſquare of $\sqrt{-a^2}$ is $-a^2$; but "the cube of an impoſſible quantity is ſtill impoſſible," as it ſtill involves the ſquare root of a negative: as, $\sqrt[2]{-a^2}\times\sqrt[2]{-a^2}\times\sqrt[2]{-a^2}=\sqrt[2]{-a^6}=a^3\sqrt{-1}$, is plainly imaginary. From which it appears, that though two ſimple equations involving impoſſible expreſſions, multiplied by one another, may give a product where no impoſſible expreſſion may appear; yet "if three ſuch "ſimple equations be multiplied by each other, the impoſſible expreſſion will not diſappear in their product." And hence it is plain, that though a quadratic equation whoſe coefficients are all real may have its two roots impoſſible, yet "a cubic equation whoſe coefficients are real cannot have all its three roots impoſſible."

In general, it appears, that the impoſſible expreſſions cannot diſappear in the equation produced, but when their number is *even*; that there are never in any equations, whoſe coefficients are real quantities, ſingle impoſſible roots, or an odd number of impoſſible roots, but "that the roots become impoſſible in pairs, and that "an equation of an odd number of dimenſions has always one real root."

"The roots of equations are either *poſitive* or *negative*, "according as the roots of the ſimple equations whence "they are produced are poſitive or negative." If you ſuppoſe $x=-a$, $x=-b$, $x=-c$, $x=-d$, &c. then ſhall $x+a=0$, $x+b=0$, $x+c=0$, $x+d=0$; and the equation $\overline{x+a}\times\overline{x+b}\times\overline{x+c}\times\overline{x+d}=0$ will have its roots, $-a$, $-b$, $-c$, $-d$, &c. negative.

But to know when the roots of equations are poſitive, and when negative, and how many there are of each kind, ſhall be explained in the next chapter.

Chap. XV. *Of the* Signs *and* Coefficients *of Equations.*

When any number of ſimple equations are multiplied by each other, it is obvious that the higheſt dimenſion of the unknown quantity in their product is equal to the number of thoſe ſimple equations; and the term involving the higheſt dimenſion is called the *firſt* term of the equation generated by this multiplication. The term involving the next dimenſion of the unknown quantity, leſs than the greateſt by unit, is called the *ſecond* term of the equation; the term involving the next dimenſion of the unknown quantity, which is leſs than the greateſt by two, the *third* term of the equation, *&c.*; and that term which involves no dimenſion of the unknown quantity, but is ſome known quantity, is called the *laſt* term of the equation.

"The number of terms is always greater than the "higheſt dimenſion of the unknown quantity by unit." And when any term is wanting, an aſteriſk is marked in its place. The ſigns and coefficients of equations will be underſtood by conſidering the following table, where the ſimple equations $x-a$, $x-b$, &c. are multiplied by one another, and produce ſucceſſively the higher equations.

$$\begin{array}{l} x-a=0\\ \times\, x-b=0\\ \hline \left.\begin{array}{l}=x^2-ax\\ \qquad -bx+ab\end{array}\right\}=0, \text{ a } \textit{quadratic.}\\ \times\, x-c=0 \end{array}$$

$$\left.\begin{array}{r}=x^3-a\\-b\\-c\end{array}\right\}\times x^2\left.\begin{array}{r}+ab\\+ac\\+bc\end{array}\right\}\times x-abc=0, \text{ a } \textit{cubic.}$$

$$\times\, x-d=0$$

$$\left.\begin{array}{r}=x^4-a\\-b\\-c\\-d\end{array}\right\}\times x^3\left.\begin{array}{r}+ab\\+ac\\+ad\\+bc\\+bd\\+cd\end{array}\right\}\times x^2\left.\begin{array}{r}-abc\\-abd\\-acd\\-bcd\end{array}\right\}\times x+abcd=0, \text{ a } \textit{biquadratic.}$$

$$\times\, x-e=0$$

$$\left.\begin{array}{r}=x^5-a\\-b\\-c\\-d\\-e\end{array}\right\}\times x^4\left.\begin{array}{r}+ab\\+ac\\+ad\\+ae\\+bc\\+bd\\+be\\+cd\\+ce\\+de\end{array}\right\}\times x^3\left.\begin{array}{r}-bc\\-abd\\-abe\\-acd\\-ade\\-ace\\-bcd\\-bce\\-bde\\-cde\end{array}\right\}\times x^2\left.\begin{array}{r}+abcd\\+abce\\+abde\\+acde\\+bcde\end{array}\right\}\times x-abcde=c,$$

&c. (a *ſurſolid.*)

From the inſpection of theſe equations it is plain, that the coefficient of the firſt term is *unit*.

The coefficient of the ſecond term is *the ſum of all the roots* (a, b, c, d, e,) *having their ſigns changed.*

The coefficient of the third term is *the ſum of all the products that can be made by multipying any two of the roots* (a, b, c, d, e,) *by one another.*

The coefficient of the fourth term is *the ſum of all the products that can be made by multiplying into one another any three of the roots, with their ſigns changed.* And after the ſame manner all the other coefficients are formed.

The laſt term is always *the product of all the roots having their ſigns changed*, multiplied by one another.

Although in the table ſuch ſimple equations only are multiplied by one another as have poſitive roots, it is eaſy to ſee, that "the coefficients will be formed according to the ſame rule when any of the ſimple equations have negative roots." And, in general, if $x^3-px^2+qx-r=0$ repreſent any cubic equation, then ſhall p be the ſum of the roots; q the ſum of the products made by multiplying any two of them; r the product of all the three: and, if $-p$, $+q$, $-r$, $+s$, $-t$, $+u$, &c. be the coefficients of the 2d, 3d, 4th, 5th, 6th, 7th, *&c.* terms of any equation, then ſhall p be the ſum of all the roots, q the ſum of the products of any two, r the ſum of the products of any three, s the ſum of the products of any four, t the ſum of the products of any five, u the ſum of the products of any ſix, *&c.*

When

When therefore any equation is proposed to be resolved, it is easy to find the sum of the roots, (for it is equal to the coefficient of the second term having its sign changed); or to find the sum of the products that can be made by multiplying any determinate number of them.

But it is also easy "to find the sum of the squares, or "of any powers, of the roots.

The sum of the squares is always p^2-2q. For calling the sum of the squares B, since the sum of the roots is p; and "the square of the sum of any quantities is "always equal to the sum of their squares added to "double the products that can be made by multiplying "any two of them," therefore $p^2=B+2q$, and consequently $B=p^2-2q$. For example, $\overline{a+b+c}|^2=a^2+b^2+c^2+2ab+2ac+2bc$; that is, $p^2=B+2q$. And $\overline{a+b+c+d}|^2=a^2+b^2+c^2+d^2+2\times\overline{ab+ac+ad+bc+bd+cd}$, that is, again, $p^2=B+2q$, or $B=p^2-2q$. And so for any other number of quantities. In general therefore, "B the "sum of the squares of the roots may always be found "by subtracting $2q$ from p^2;" the quantities p and q being always known, since they are the coefficients in the proposed equation.

"The sum of the cubes of the roots of any equation is equal to $p^3-3pq+3r$, or to $Bp-pq+3r$." For $\overline{B-q}\times p$ gives always the excess of the sum of the cubes of any quantities above the triple sum of the products that can be made by multiplying any three of them. Thus, $\overline{a^2+b^2+c^2-ab-ac-bc}\times\overline{a+b+c}\,(=\overline{B-q}\times p)=a^3+b^3+c^3-3abc$. Therefore if the sum of the cubes is called C, then shall $\overline{B-q}\times p=C-3r$, and $C=Bp-qp+3r=$ (because $B=p^2-2q$) $=p^3-3pq+3r$.

After the same manner, if D be the sum of the 4th powers of the roots, you will find that $D=pC-qB+pr-4s$, and if E be the sum of the 5th powers, then shall $E=pD-qC+rB-ps+5t$. And after the same manner the sum of any powers of the roots may be found; the progression of these expressions of the sum of the powers being obvious.

As for the signs of the terms of the equation produced, it appears, from inspection, that the signs of all the terms in any equation in the table are alternately $+$ and $-$: these equations are generated by multiplying continually $x-a$, $x-b$, $x-c$, $x-d$, &c. by one another. The first term is always some pure power of x, and is positive; the second is a power of x multiplied by the quantities $-a$, $-b$, $-c$, &c. And since these are all negative, that term must therefore be negative. The third term has the products of any two of these quantities ($-a$, $-b$, $-c$, &c.) for its coefficient; which products are all positive, because $-\times-$ gives $+$. For the like reason, the next coefficient, consisting of all the products made by multiplying any three of these quantities must be negative, and the next positive. So that the coefficients, in this case, will be positive and negative by turns. But, "in this case the roots are all positive;" since $x=a$, $x=b$, $x=c$, $x=d$, $x=e$, &c. are the assumed simple equations. It is plain then, that "when all the "roots are positive, the signs are alternately $+$ and $-$."

But if the roots are all negative, then $\overline{x+a}\times\overline{x+b}\times\overline{x+c}\times\overline{x+d}$, &c. $=0$. will express the equation to be produced; all whose terms will plainly be positive; so that, "when all the roots of an equation are negative, it is "plain there will be no changes in the signs of the terms "of that equation."

In general, "there are as many positive roots in any e-"quation as there are changes in the signs of the terms from $+$ to $-$, or from $-$ to $+$; and the remaining "roots are negative." The rule is general, if the impossible roots be allowed to be either positive or negative; and may be extended to all kinds of equations.

In quadratic equations, the two roots are either both positive, as in this

$$(\overline{x-a}\times\overline{x-b}=)\; x^2\begin{array}{l}-ax\\-bx\end{array}+ab=0,$$

where there are two changes of the signs: Or they are both negative, as in this

$$(\overline{x+a}\times\overline{x+b}=)\; x^2\left.\begin{array}{l}+a\\+b\end{array}\right\}x+ab=0,$$

where there is not any change of the signs: Or there is one positive and one negative, as in

$$(\overline{x-a}\times\overline{x+b}=)\; x^2\left.\begin{array}{l}-a\\+b\end{array}\right\}x-ab=0,$$

where there is necessarily one change of the signs; because the first term is positive, and the last negative, and there can be but one change whether the 2d term be $+$ or $-$.

Therefore the rule given in the last paragraph extends to all quadratic equations.

In cubic equations, the roots may be,

1°. All positive, as in this; $\overline{x-a}\times\overline{x-b}\times\overline{x-c}=0$, in which the signs are alternately $+$ and $-$, as appears from the table; and there are three changes of the signs.

2°. The roots may be all negative, as in the equation $\overline{x+a}\times\overline{x+b}\times\overline{x+c}=0$, where there can be no change of the signs. Or,

3°. There may be two positive roots and one negative, as in the equation $\overline{x-a}\times\overline{x-b}\times\overline{x+c}=0$; which gives

$$x^3\left.\begin{array}{l}-a\\-b\\+c\end{array}\right\}x^2\left.\begin{array}{l}+ab\\-ac\\-bc\end{array}\right\}x+abc=0.$$

Here there must be two changes of the signs; because if $a+b$ is greater than c, the second term must be negative, its coefficient being $-a-b+c$.

And if $a+b$ is less than c, then the third term must be negative, its coefficient $+ab-ac-bc\,(ab-c\times\overline{a+b})$ * being in that case negative. And there cannot possibly be three changes of the signs, the first and last terms having the same sign.

4°. There may be one positive root and two negative, as in the equation $\overline{x+a}\times\overline{x+b}\times\overline{x-c}=0$, which gives

$$x^3\left.\begin{array}{l}+a\\+b\\-c\end{array}\right\}x^2\left.\begin{array}{l}+ab\\-ac\\-bc\end{array}\right\}x-abc=0.$$

where

* *Because the rectangle* a×b *is less than the square* $\overline{a+b}\times\overline{a+b}$, *and therefore much less than* $\overline{a+b}\times c$.

where there muſt be always one change of the ſigns, ſince the firſt term is poſitive and the laſt negative. And there can be but one change of the ſigns, ſince if the 2d term is negative, or $a+b$ leſs than c, the third muſt be negative alſo, ſo that there will be but one change of the ſigns. Or, if the ſecond term is affirmative, whatever the third term is, there will be but one change of the ſigns. It appears therefore, in general, that in cubic equations, there are as many affirmative roots as there are changes of the ſigns of the terms of the equation.

There are ſeveral confectaries of what has been already demonſtrated, that are of uſe in diſcovering the roots of equations. But before we proceed to that, it will be convenient to explain ſome transformations of equations, by which they may often be rendered more ſimple, and the inveſtigation of their roots more eaſy.

Chap. XVI. *Of the Transformation of Equations; and exterminating their intermediate Terms.*

We now proceed to explain the transformation of equations that are moſt uſeful: and, firſt, "The affirmative roots of an equation are changed into negative "roots of the ſame value, and the negative roots into "affirmative, by only changing the ſigns of the terms "alternately, beginning with the ſecond." Thus, the roots of the equation $x^4-x^3-19x^2+49x-30=0$ are $+1$, $+2$, $+3$, -5; whereas the roots of the ſame equation having only the ſigns of the ſecond and fourth terms changed, *viz.* $x^4+x^3-19x^2+49x-30=0$ are -1, -2, -3, $+5$.

To underſtand the reaſon of this rule, let us aſſume an equation, as $\overline{x-a}\times\overline{x-b}\times\overline{x-c}\times\overline{x-d}\times\overline{x-e}$, &c. $=0$, whoſe roots are $+a$, $+b$, $+c$, $+d$, $+e$, &c. and another, having its roots of the ſame value, but affected with contrary ſigns, as $\overline{x+a}\times\overline{x+b}\times\overline{x+c}\times\overline{x+d}\times\overline{x+e}$, &c. $=0$. It is plain, that the terms taken alternately, beginning from the firſt, are the ſame in both equations, and have the ſame ſign, "being products of an even number "of the roots;" the product of any two roots having the ſame ſign as their product when both their ſigns are changed; as $+a\times-b=-a\times+b$.

But the ſecond terms, and all taken alternately from them, becauſe their coefficients involve always the products of an odd number of the roots, will have contrary ſigns in the two equations. For example, the product of four, *viz.* $abcd$, having the ſame ſign in both, and one equation in the fifth term having $abcd\times+e$, and the other $abcd\times-e$, it follows, that their product $abcde$ muſt have contrary ſigns in the two equations: theſe two equations therefore that have the ſame roots, but with contrary ſigns, have nothing different but the ſigns of the alternate terms, beginning with the ſecond. From which it follows, "that if any equation is given, and "you change the ſigns of the alternate terms, beginning with the ſecond, the new equation will have roots "of the ſame value, but with contrary ſigns."

It is often very uſeful "to transform an equation into "another that ſhall have its roots greater or leſs than "the roots of the propoſed equation by ſome given difference."

Let the equation propoſed be the cubic $x^3-px^2+qx-r=0$. And let it be required to transform it into another equation whoſe roots ſhall be leſs than the roots of this equation by ſome given difference (e), that is, ſuppoſe $y=x-e$, and conſequently $x=y+e$; then, inſtead of x and its powers, ſubſtitute $y+e$ and its powers, and there will ariſe this new equation.

$$(A)\left.\begin{aligned} y^3+3ey^2+3e^2y&+e^3\\ -py^2-2pey&-pe^2\\ +qy&+qe\\ &-r \end{aligned}\right\}=0,$$

whoſe roots are leſs than the roots of the preceding equation by the difference (e).

If it had been required to find an equation whoſe roots ſhould be greater than thoſe of the propoſed equation by the quantity (e), then we muſt have ſuppoſed $y=x+e$, and conſequently $x=y-e$, and then the other equation would have had this form.

$$(B)\left.\begin{aligned} y^3-3ey^2+3e^2y&-e^3\\ -py^2+2pey&-pe^2\\ +qy&-qe\\ &-r \end{aligned}\right\}=0.$$

If the propoſed equation be in this form $x^3+px^2+qx+r=0$, then, by ſuppoſing $x+e=y$, there will ariſe an equation agreeing in all reſpects with the equation (A), but that the ſecond and fourth terms will have contrary ſigns.

And by ſuppoſing $x-e=y$, there will ariſe an equation agreeing with (B) in all reſpects, but that the ſecond and fourth terms will have contrary ſigns to what they have in (B).

The firſt of theſe ſuppoſitions gives this equation,

$$(C)\left.\begin{aligned} y^3-3ey^2+3e^2y&-e^3\\ +py^2-2pey&+pe^2\\ +qy&-qe\\ &+r \end{aligned}\right\}=0.$$

The ſecond ſuppoſition gives the equation,

$$(D)\left.\begin{aligned} y^3+3ey^2+3e^2y&+e^3\\ +py^2+2epy&+pe^2\\ +qy&+qe\\ &+r \end{aligned}\right\}=0.$$

The firſt uſe of this transformation of equations is to ſhew "how the ſecond (or other intermediate) term may "be taken away out of an equation."

It is plain, that in the equation (A) whoſe ſecond term is $\overline{3e-p}\times y^2$, if you ſuppoſe $e=\frac{1}{3}p$, and conſequently $3e-p=0$, then the ſecond term will vaniſh

In the equation (C) whoſe ſecond term is $-\overline{3e+p}\times y^2$, ſuppoſing $e=\frac{1}{3}p$, the ſecond term alſo vaniſhes.

Now the equation (A) was deduced from $x^3-px^2+qx-r=0$, by ſuppoſing $y=x-e$: and the equation (C) was deduced from $x^3+px^2+qx+r=0$; by ſuppoſing $y=x+e$. From which this rule may eaſily be deduced for exterminating the ſecond term out of any cubic equation.

Rule.

RULE. Add to the unknown quantity of the given equation the third part of the coefficient of the second term with its proper sign, *viz.* $\mp\frac{1}{3}p$, and suppose this aggregate equal to a new unknown quantity (y). From this value of y find a value of x by transposition, and substitute this value of x and its powers in the given equation, and there will arise a new equation that shall want the second term.

EXAMP. Let it be required to exterminate the second term out of this equation, $x^3-9x^2+26x-34=0$, suppose $x-3=y$, or $y+3=x$; and substituting according to the rule, you will find

$$\left.\begin{array}{r} y^3+9y^2+27y+27 \\ -9y^2-54y-81 \\ +26y+78 \\ -34 \end{array}\right\}=0$$

$$y^3 \; * \; -y-10=0.$$

In which there is no term where y is of two dimensions, and an asterisk is placed in the room of the 2d term, to shew it is wanting.

Let the equation proposed be of any number of dimensions represented by (n); and let the coefficient of the second term with its sign prefixed be $-p$, then supposing $x-\frac{p}{n}=y$, and consequently $x=y+\frac{p}{n}$, and substituting this value for x in the given equation, there will arise a new equation that shall want the second term.

It is plain from what was demonstrated in chap. 15. that the sum of the roots of the proposed equation is $+p$; and since we suppose $y=x-\frac{p}{n}$, it follows, that, in the new equation, each value of y will be less than the respective value of x by $\frac{p}{n}$; and, since the number of the roots is n, it follows, that the sum of the values of y will be less than $+p$, the sum of the values of x, by $n\times\frac{p}{n}$, the difference of any two roots, that is, by $+p$: therefore the sum of the values of y will be $+p-p=0$.

But the coefficient of the second term of the equation of y is the sum of the values of y, viz. $+p-p$, and therefore that coefficient is equal to nothing; and consequently, in the equation of y, the second term vanishes. It follows then, that the second term may be exterminated out of any given equation by the following

RULE. Divide the coefficient of the second term of the proposed equation by the number of dimensions of the equation; and assuming a new unknown quantity y, add to it the quotient having its sign changed. Then suppose this aggregate equal to x the unknown quantity in the proposed equation; and for x and its powers, substitute the aggregate and its powers, so shall the new equation that arises want its second term.

If the proposed equation is a quadratic, as $x^2-px+q=0$, then, according to the rule, suppose $y+\frac{1}{2}p=x$, and substituting this value for x, you will find,

$$\left.\begin{array}{r} y^2+py+\frac{1}{4}p^2 \\ -py-\frac{1}{2}p^2 \\ +\;q \end{array}\right\}=0,$$

$$y^2 \; * -\tfrac{1}{4}p^2+q=0.$$

And from this example the use of exterminating the 2d term appears: for commonly the solution of the equation that wants the 2d term is more easy. And, if you can find the value of y from this new equation, it is easy to find the value of x, by means of the equation $y+\frac{1}{2}p=x$. For example,

Since $y^2+q-\frac{1}{4}p^2=0$, it follows, that $y^2=\frac{1}{4}p^2-q$, and $y=\pm\sqrt{\frac{1}{4}p^2-q}$, so that $x=y+\frac{1}{2}p=\frac{1}{2}p\pm\sqrt{\frac{1}{4}p^2-q}$;

which agrees with what we demonstrated, *chap.* 12.

If the proposed equation is a biquadratic, as $x^4-px^3+qx^2-rx+r=0$, then, by supposing $x-\frac{1}{4}p=y$ or $x=y+\frac{1}{4}p$, an equation shall arise having no second term. And if the proposed equation is of 5 dimensions, then you must suppose $x=y\pm\frac{1}{5}p$. And so on.

When the second term in any equation is wanting, it follows, that "the equation has both affirmative and negative roots," and that "the sum of the affirmative roots is equal to the sum of the negative roots:" by which means the coefficient of the 2d term, which is the sum of all the roots of both sorts, vanishes, and makes the second term vanish.

In general, "The coefficient of the 2d term is the difference between the sum of the affirmative roots roots and the sum of the negative roots:" and the operations we have given serve only to diminish all the roots when the sum of the affirmative is greatest, or increase the roots when the sum of the negative is greatest, so as to balance them, and reduce them to an equality.

It is obvious, that in a quadratic equation that wants the second term, there must be one root affirmative and one negative; and these must be equal to one another.

In a cubic equation that wants the second term, there must be either two affirmative roots equal, taken together to a third root that must be negative; or, two negative equal to a third that must be positive.

"Let an equation $x^3-px^2+qx-r=0$ be proposed, "and let it be now required to exterminate the third "term."

By supposing $y=x-e$, the coefficient of the 3d term in the equation of y is found (see equation A) to be $3e^2-2pe+q$. Suppose that coefficient equal to nothing, and by resolving the quadratic equation $3e^2-2pe+q=0$, you will find the value of e, which substituted for it in the equation $y=x-e$, will shew how to transform the proposed equation into one that shall want the third term.

The quadratic $3e^2-2pe+q=0$, gives $e=\frac{p\pm\sqrt{p^2-3q}}{3}$.

So that the proposed cubic will be transformed into an equation wanting the third term by supposing $y=x-\frac{p-\sqrt{p^2-3q}}{3}$, or $y=x-\frac{p+\sqrt{p^2-3q}}{3}$.

If

If the propofed equation is of n dimenfions, the value of e, by which the 3d term may be taken away, is had by refolving the quadratic equation $e^2+\frac{2p}{n}\times e+\frac{2q}{n\times n-1}=0$, fuppofing $-p$ and $+q$ to be the coefficients of the 2d and 3d terms of the propofed equation.

The 4th term of any equation may be taken away by folving a cubic equation, which is the coefficient of the 4th term in the equation when transformed, as in the former part of this chapter. The fifth term may be taken away by folving a biquadratic; and after the fame manner the other terms can be exterminated if there are any.

There are other tranfmutations of equations that, on fome occafions, are ufeful.

An equation, as $x^3-px^2+qx-r=0$, "may be trans-"formed into another that fhall have its roots equal to "the roots of this equation multiplied by a given quan-"tity," as f, by fuppofing $y=fx$, and confequently $x=\frac{y}{f}$, and fubftituting this value for x in the propofed equation, there will arife $\frac{y^3}{f^3}-\frac{py^2}{f^2}+\frac{qy}{f}-r=0$, and multiplying all by f^3 . . $y^3-fpy^2+f^2qy-f^3r=0$, where the coefficient of the 2d term of the propofed equation multiplied into f, makes the coefficient of the 2d term of the transformed equation; and the following coefficients are produced by the following coefficients of the propofed equation, (as q, r, &c.) multiplied into the powers of f (f^2, f^3, &c.).

Therefore "to transform any equation into another whofe roots fhall be equal to the roots of the propofed equation multiplied by a given quantity (f)," you need only multiply the terms of the propofed equation, beginning at the 2d term, by f, f^2, f^3, f^4, &c. and putting y inftead of x, there will arife an equation having its roots equal to the roots of the propofed equation multiplied by (f) as required.

The transformation mentioned above is of ufe when the higheft term of the equation has a coefficient different from unity; for, by it, the equation may be transformed into one that fhall have the coefficient of the higheft term unit.

If the equation propofed is $ax^3-px^2+qx-r=0$, then transform the equation into one whofe roots are equal to the roots of the propofed equation multiplied by (a). That is, fuppofe $y=ax$ or $x=\frac{y}{a}$ and there will arife

$\frac{ay^3}{a^3}-\frac{py^2}{a^2}+\frac{qy}{a}-r=0$; fo that

$y^3-py^2+qay-ra^2=0$.

From which we eafily draw this

Rule. Change the unknown quantity x into another y, prefix no coefficient to the higheft term, pafs the 2d, multiply the following terms, beginning with the 3d, by a, a^2, a^3, a^4, &c. the powers of the coefficient of the higheft term of the propofed equation, refpectively.

Thus the equation $3x^3-13x^2+14x+16=0$, is transformed into the equation $y^3-13y^2+14\times3\times x+16\times9=0$, or $y^3-13y^2+42x+144=0$.

Then finding the roots of this equation, it will eafily be difcovered what are the roots of the propofed equation, fince $3x=y$, or $x=\frac{1}{3}y$. And therefore, fince one of the values of y is -2, it follows, that one of the values of x is $-\frac{2}{3}$.

By the laft rule, "an equation is eafily cleared of "fractions." Suppofe the equation propofed is $x^3-\frac{p}{m}x^2+\frac{q}{n}x-\frac{r}{e}=0$. Multiply all the terms by the product of the denominators, you find

$$mne\times x^3-nep\times x^2+meq\times x-mnr=0.$$

Then (as above) transforming the equation into one that fhall have unit for the coefficient of the higheft term, you find

$$y^3-nep\times y^2+m^2e^2nq\times y-m^3n^3e^2r=0.$$

Or, neglecting the denominator of the laft term $\frac{r}{e}$ you need only multiply all the equation by mn, which will give

$$mn\times x^3-np\times x^2+mq\times x-\frac{mnr}{e}=0.$$ And

then $$y^3-np\times y^2+m^2nq\times y-\frac{m^3n^2r}{e}=0.$$

Now after the values of y are found, it will be eafy to difcover the values of x; fince, in the firft cafe, $x=\frac{y}{mne}$; in the fecond, $x=\frac{y}{mn}$.

For example, the equation

$x^{3*}-\frac{4}{3}x-\frac{145}{27}=0$, is firft reduced to this form $3x^{3*}-4x-\frac{146}{9}=0$, and then transformed into $y^{3*}-12y-146=0$.

Sometimes, by thefe transformations, "furds are ta-"ken away." As for example,

The equation $x^3-p\sqrt{a}\times x^2+qx-r\sqrt{a}=0$, by putting $y=\sqrt{a}\times x$, or $x=\frac{y}{\sqrt{a}}$, is transformed into this equation, $\frac{y^3}{a\sqrt{a}}-p\sqrt{a}\times\frac{y^2}{a}+qx\frac{y}{\sqrt{a}}-r\sqrt{a}=0$. Which, by multiplying all the terms by $a\sqrt{a}$, becomes $y^3-pay^2+qay-ra^2=0$, an equation free of furds. But in order to make this fucceed, the furd ($\sqrt{a}$) muft enter the alternate terms, beginning with the fecond.

"An equation, as $x^3-px^2+qx-r=0$, may be trans-"formed into one whofe roots fhall be the quantities re-"ciprocal of x;" by fuppofing $y=\frac{1}{x}$, and $y=\frac{z}{r}$, or (by one fuppofition), $x=\frac{r}{z}$, becomes $z^3-qz^2+prz-r^2=0$.

In the equation of y, it is manifeft, that the order of the coefficients is inverted; fo that, if the fecond term had been wanting in the propofed equation, the laft but one fhould have been wanting in the equations of y and z. If the 3d had been wanting in the equation propofed, the laft but two had been wanting in the equations of y and z.

Another ufe of this transformation is, that *the greateft*

est root in the one is transformed into the least root in the other. For since $x = \frac{1}{y}$, and $y = \frac{1}{x}$, it is plain, that when the value of x is greatest, the value of y is least, and conversely.

How an equation is transformed so as to have all its roots affirmative, shall be explained in the following chapter.

CHAP. XVII. *Of finding the* ROOTS *of Equations when two or more of the Roots are equal to each other.*

§1. BEFORE we proceed to explain how to resolve equations of all sorts, we shall first demonstrate *how an equation that has two or more roots equal, is depressed to a lower dimension*; and its resolution made, consequently, more easy. And shall endeavour to explain the grounds of this and many other rules we shall give in the remaining part of this treatise, in a more simple and concise manner than has hitherto been done.

In order to this, we must look back to the last chapter, where we find, that if any equation, as $x^3 - px^2 + qx - r = 0$, is proposed, and you are to transform it into another that shall have its roots less than the values of x by any given difference, as e, you are to assume $y = x - e$, and substituting for x its value $y + e$, you find the transformed equation,

$$\left.\begin{array}{r} y^3 + 3ey^2 + 3e^2y + e^3 \\ - py^2 - 2pey - pe^2 \\ + qy + qe \\ - r \end{array}\right\} = 0.$$

Where we are to observe,

1°. That the last term $(e^3 - pe^2 + qe - r)$ is the very equation that was proposed, having e in place of x.

2°. The coefficient of the last term but one is $3e^2 - 2pe + q$, which is the quantity that arises by multiplying every term of the last coefficient $e^3 - pe^2 + qe - r$ by the index of e in each term, and dividing the product $3e^3 - 2pe^2 + qe$ by the quantity e that is common to all the terms.

3°. The coefficient of the last term but two is $3e - p$, which is the quantity that arises by multiplying every term of the coefficient last found $(3e^2 - 2pe + q)$ by the index of e in each term, and dividing the whole by $2e$.

§2. These same observations extend to equations of all dimensions. If it is the biquadratic $x^4 - px^3 + qx^2 - rx + s = 0$ that is proposed, then by supposing $y = x - e$, it will be transformed into this other,

$$\left.\begin{array}{r} y^4 + 4ey^5 + 6e^2y^2 + 4e^3y + e^4 \\ - py^3 - 3pey^2 - 3pe^2y - pe^3 \\ + qy^2 + 2qey + qe^2 \\ - ry - re \\ + s \end{array}\right\} = 0$$

Where again it is obvious, That the last term is the equation that was proposed, having e in place of x: That the last term but one has for its coefficient the quantity that arises by multiplying the terms of the last quantity by the indices of e in each term, and dividing the product by e: That the coefficient of the last term but two, (*viz.* $6e^2 - 3pe + q$) is deduced in the same manner from the term immediately following, that is, by multiplying every term of $4e^3 - 3pe^2 + 2qe - r$ by the index of e in that term, and dividing the whole by e multiplied into the index of y in the term sought, that is, by $e \times 2$: And the next term is $4e - p = \frac{6e^2 \times 2 - 3pe \times 1}{3e}$.

The demonstration of this may easily be made general by the theorem for finding the powers of a binomial, since the transformed equation consists of the powers of the binomial $y + e$ that are marked by the indices of e in the last term, multiplied each by their coefficients 1, $-p$, $+q$, $-r$, $+s$, &c. respectively.

§3. From the last two articles we can easily find the terms of the transformed equation without any involution. The last term is had by substituting e instead of x in the proposed equation; the next term, by multiplying every part of that last term by the index of e in each part, and dividing the whole by e; and the following terms in the manner described in the foregoing article; the respective divisors being the quantity e multiplied by the index of y in each term.

The demonstration for finding when two or more roots are equal will be easy, if we add to this, that "when the unknown quantity enters all the terms of any equation, then one of its values is equal to nothing." As in the equation $x^3 - px^2 + qx = 0$, where $x - 0 = 0$ being one of the simple equations that produce $x^3 - px^2 + qx = 0$, it follows that one of the values of x is 0. In like manner, two of the values of x are equal to nothing in this equation $x^3 - px^2 = 0$; and three of them vanish in the equation $x^4 - px^3 = 0$.

It is also obvious (*conversely*) that "if x does not enter all the terms of the equation, *i. e.* if the last term be not wanting, then none of the values of x can be equal to nothing," for if every term be not multiplied by x, then $x - 0$ cannot be a divisor of the whole equation, and consequently 0 cannot be one of the values of x. If x^2 does not enter into all the terms of the equation, then two of the values of x cannot be equal to nothing. If x^3 does not enter into all the terms of the equation, then three of the values of x cannot be equal to nothing, *&c.*

§4. Suppose now that two values of x are equal to one another, and to e; then it is plain that two values of y in the transformed equation will be equal to nothing: since $y = x - e$. And consequently, by the last article, the two last terms of the transformed equation must vanish.

Suppose it is the cubic equation of §1. that is proposed, *viz.* $x^3 - px^2 + qx - r = 0$; and because we suppose $x = e$, therefore the last term of the transformed equation, *viz.* $e^3 - pe^2 + qe - r$ will vanish. And since two values of y vanish, the last term but one, *viz.* $3e^2y - 2pey + qy$ will vanish at the same time. So that $3e^2 - 2pe + q = 0$. But, by supposition, $e = x$; therefore, when two values of x, in the equation, $x^3 - px^2 + qx - r = 0$, are equal, it follows, that $3x^2 - 2px + q = 0$. And thus,

thus, " the proposed cubic is depressed to a quadratic " that has one of its roots equal to one of the roots of " that cubic."

If it is the biquadratic that is proposed, *viz.* $x^4 - px^3 + qx^2 - rx + s = 0$, and two of its roots be equal; then supposing $e = x$, two of the values of y must vanish, and the equation of § 2. will be reduced to this form.

$$\left.\begin{array}{r} y^4 + 4ey^3 + 6e^2y^2 \\ -py^3 - 3pey^2 \\ + qy^2 \end{array}\right\} * * = 0. \quad \text{So that}$$

$4e^3 - 3pe^2 + 2qe - r = 0$; or, because $x = e$, $4x^3 - 3px^2 + 2qx - r = 0$.

In general, when two values of x are equal to each other, and to e, the two last terms of the transformed equation vanish: and consequently, " if you multiply " the terms of the proposed equation by the indices of " x in each term, the quantity that will arise will be $= 0$, " and will give an equation of a lower dimension than " the proposed, that shall have one of its roots equal " to one of the roots of the proposed equation."

That the last two terms of the equation vanish when the values of x are supposed equal to each other, and to e, will also appear by considering, that since two values of y then become equal to nothing, the product of the values of y must vanish, which is equal to the last term of the equation; and because two of the four values of y are equal to nothing, it follows also that one of any three that can be taken out of these four must be $= 0$; and therefore, the products made by multiplying any three must vanish; and consequently the coefficient of the last term but one, which is equal to the sum of these products, must vanish.

§ 5. After the same manner, if there are three equal roots in the biquadratic $x^4 - px^3 + qx^2 - rx + s = 0$, and if e be equal to one of them, three values of y $(= x - e)$ will vanish, and consequently y^3 will enter all the terms of the transformed equation; which will have this form,

$$\left.\begin{array}{r} y^4 + 4ey^3 \\ -py^3 \end{array}\right\} * * * = 0. \quad \text{So that here}$$

$6e^2 - 3pe + q = 0$; or, since $e = x$, therefore, $6x^2 - 3px + q = 0$: and one of the roots of this quadratic will be equal to one of the roots of the proposed biquadratic.

In this case, two of the roots of the cubic equation $4x^3 - 3px^2 + 2qx - r = 0$ are roots of the proposed biquadratic, because the quantity $6x^2 - 3px + q$ is deduced from $4x^3 - 3px^2 + 2qx - r$, by multiplying the terms by the indexes of x in each term.

In general, " whatever is the number of equal roots " in the proposed equation, they will all remain but one " in the equation that is deduced from it, by multiplying " all the terms by the indexes of x in them; and they " will all remain but two in the equation deduced in the " same manner from that;" and so of the rest.

§ 6. What we observed of the coefficients of equations transformed by supposing $y = x - e$, leads to this easy demonstration of this rule; and will be applied in the next chapter to demonstrate the rules for finding the limits of equations.

It is obvious, however, that though we make use of equations whose signs change alternately, the same reasoning extends to all other equations.

It is a consequence also of what has been demonstrated, that " if two roots of any equation, as,

" $x^3 - px^2 + qx - r = 0$, are equal, then " multiplying the terms by any arithmetical series, as, " $a + 3b$, $a + 2b$, $a + b$, a, the product will be $= 0$."

For, since

$$\begin{array}{l} ax^3 - apx^2 + aqx - ar = 0; \text{ and} \\ 3x^2 - 2px + qx bx = 0, \text{ it follows that} \\ ax^3 + 3bx^3 - apx^2 - 2bpx^2 + aqx + bqx - ar = 0. \end{array}$$

Which is the product that arises by multiplying the terms of the proposed equation by the terms of the series, $a + 3b$, $a + 2b$, $a + b$, a; which may represent any arithmetical progression.

Chap. XVIII. *Of the* Limits *of Equations.*

We now proceed to shew how to discover the limits of the roots of equations, by which their solution is much facilitated.

Let any equation, as $x^3 - px^2 + qx - r = 0$ be proposed; and transform it, as above, into the equation

$$\left.\begin{array}{r} y^3 + 3ey^2 + 3e^2y + e^3 \\ -py^2 - 2pey - pe^2 \\ + qy + qe \\ - r \end{array}\right\} = 0.$$

Where the values of y are less than the respective values of x by the difference e. If you suppose e to be taken such as to make all the coefficients of the equation of y positive, *viz.* $e^3 - pe^2 + qe - r$, $3e^2 - 2pe + q$, $3e - p$; then there being no variation of the signs in the equation, all the values of y must be negative; and consequently, the quantity e, by which the values of x are diminished, must be greater than the greatest positive value of x; and consequently must be the limit of the roots of the equation $x^3 - px^2 + qx - r = 0$.

It is sufficient therefore, in order to find the limit, to " inquire what quantity substituted for x in each of these " expressions $x^3 - px^2 + qx - r$, $3x^2 - 2px + q$, $3x - p$, " will give them all positive;" for that quantity will be the limit required.

How these expressions are formed from one another, was explained in the beginning of the last chapter.

Examp. If the equation $x^5 - 2x^4 - 10x^3 + 30x^2 + 63x + 120 = 0$ is proposed; and it is required to determine the limit that is greater than any of the roots; you are to inquire what integer number substituted for x in the proposed equation, and following equations deduced from it by § 3. chap. 17. will give, in each, a positive quantity,

$$\begin{array}{l} 5x^4 - 8x^3 - 30x^2 + 60x + 63 \\ 5x^3 - 6x^2 - 15x + 15 \\ 5x^2 - 4x - 5 \\ 5x - 2. \end{array}$$

The least integer number which gives each of these positive, is 2; which therefore is the limit of the roots of

of the propoſed equation; or a number that exceeds the greateſt poſitive root.

If the limit of the *negative* roots is required, you may (by chap. 16.) change the negative into poſitive roots; and then proceed as before to find their limits. Thus, in the example, you will find, that -3 is the limit of the negative roots. So that the five roots of the propoſed equation are betwixt -3 and $+2$.

Having found the limit that ſurpaſſes the greateſt poſitive root, call it m. And if you aſſume $y=m-x$, and for x ſubſtitute $m-y$, the equation that will ariſe will have all its roots poſitive; becauſe m is ſuppoſed to ſurpaſs all the values of x, and conſequently $m-x$ $(=y)$ muſt always be affirmative. And, by this means, *any equation may be changed into one that ſhall have all its roots affirmative.*

Or, if $-n$ repreſent the limit of the negative roots, then by aſſuming $y=x+n$, the propoſed equation ſhall be transformed into one that ſhall have all its roots affirmative; for $+n$ being greater than any negative value of x, it follows, that $y=x+n$ muſt be always poſitive.

The greateſt negative coefficient of any equation increaſed by unit, always exceeds the greateſt root of the equation.

To demonſtrate this, let the cubic $x^3-px^2-qx-r=0$ be propoſed; where all the terms are negative except the firſt. Aſſuming $y=x-e$, it will be transformed into the following equation;

$$(A)\left.\begin{array}{l} y^3+3ey^2+3e^2y+e^3 \\ \quad -py^2-2pey-pe^2 \\ \quad\quad -qy-qe \\ \quad\quad\quad -r \end{array}\right\}=0.$$

1°. Let us ſuppoſe that the coefficients p, q, r, are equal to each other; and if you alſo ſuppoſe $e=p+1$, then the laſt equation becomes

$$(B)\left.\begin{array}{l} y^3+2py^2+p^2y+1 \\ \quad +3y^2+3py \\ \quad\quad +3y \end{array}\right\}=0;$$

where all the terms being poſitive, it follows that the values of y are all negative, and that conſequently e, or $p+1$, is greater than the greateſt value of x in the propoſed equation.

2°. If q and r be not $=p$, but leſs than it, and for e you ſtill ſubſtitute $p+1$ (ſince the negative part $\left(\begin{array}{r}-qy-qe\\-r\end{array}\right)$ becomes leſs, the poſitive remaining undiminiſhed,) *à fortiori*, all the coefficients of the equation (A) become poſitive. And the ſame is obvious if q and r have poſitive ſigns, and not negative ſigns, as we ſuppoſed. It appears therefore, "that if, in any cubic equation, p "be the greateſt negative coefficient, then $p+1$ muſt ſurpaſs the greateſt value of x."

3°. By the ſame reaſoning it appears, that if q be the greateſt negative coefficient of the equation, and $e=q+1$, then there will be no variation of the ſigns in the equation of y: for it appears from the laſt article, that if all the three $(p, q, r,)$ were equal to one another, and e equal to any one of them increaſed by unit, as to $q+1$, then all the terms of the equation (A) would be poſitive. Now if e be ſuppoſed ſtill equal to $q+1$, and p and r to be leſs than q, then, *a fortiori*, all theſe terms will be poſitive, the negative part, which involves p and r being diminiſhed, while the poſitive part and the negative involving q remain as before.

4°. After the ſame manner it is demonſtrated, that if r is the greateſt negative coefficient in the equation, and e is ſuppoſed $=r+1$, then all the terms of the equation (A) of y will be poſitive; and conſequently $r+1$ will be greater than any of the values of x.

What we have ſaid of the *cubic* equation $x^3-px^2+qx-r=0$, is eaſily applicable to others.

In general, we conclude, that "the greateſt negative "coefficient in any equation increaſed by unit, is always "a limit that exceeds all the roots of that equation."

But it is to be obſerved at the ſame time, that the greateſt negative coefficient increaſed by unit, is very ſeldom the *neareſt* limit: that is beſt diſcovered by the rule in the beginning of this chapter.

Having ſhewn how to change any propoſed equation into one that ſhall have all its roots affirmative; we ſhall only treat of ſuch as have all their roots poſitive, in what remains relating to the limits of equations.

Any ſuch equation may be repreſented by $\overline{x-a}\times\overline{x-b}\times\overline{x-c}\times\overline{x-d}$, &c. $=0$, whoſe roots are a, b, c, d, &c.

And of all ſuch equations two limits are eaſily diſcovered from what precedes, *viz.* 0, which is leſs than the leaſt, and e, found as directed in the beginning of this chapter, which ſurpaſſes the greateſt root of the equation.

But, beſides theſe, we ſhall now ſhew how *to find other limits betwixt the roots themſelves.* And, for this purpoſe, will ſuppoſe a to be the leaſt root, b the ſecond root, c the third, and ſo on; it being arbitrary.

If you ſubſtitute 0 in place of the unknown quantity, putting $x=0$, the quantity that will ariſe from that ſuppoſition is the laſt term of the equation, all the others that involve x vaniſhing.

If you ſubſtitute for x a quantity leſs than the leaſt root a, the quantity reſulting will have the ſame ſign as the laſt term; that is, will be poſitive or negative according as the equation is of an even or odd number of dimenſions. For all the factors $x-a$, $x-b$, $x-c$, &c. will be negative, and their product will be *poſitive* or *negative* according as their number is *even* or *odd*.

If you ſubſtitute for x a quantity greater than the leaſt root a, but leſs than all the other roots, then the ſign of the quantity reſulting will be contrary to what it was before; becauſe one factor $(x-a)$ becomes now poſitive, all the others remaining negative as before.

If you ſubſtitute for x a quantity greater than the two leaſt roots, but leſs than all the reſt, both the factors $x-a$, $x-b$, become poſitive, and the reſt remain as they were. So that the whole product will have the ſame ſign as the laſt term of the equation. Thus ſucceſſively placing inſtead of x quantities that are limits betwixt the roots of the equation, the quantities that reſult will have alternately the ſigns $+$ and $-$. And, *converſely*, "if you find quantities which, ſubſtituted in "place of x in the propoſed equation, do give alternately poſitive and negative reſults, thoſe quantities "are the limits of that equation."

It is useful to observe, that, in general, " when, by " substituting any two numbers for x in any equation, " the results have contrary signs, one or more of the " roots of the equation must be betwixt those numbers." Thus, in the equation, $x^3-2x^2-5=0$, if you substitute 2 and 3 for x, the results are -5, $+4$; whence it follows, that the roots are betwixt 2 and 3: for when these results have different signs, one or other of the factors which produce the equations must have changed its sign; suppose it is $x=e$, then it is plain that e must be betwixt the numbers supposed equal to x.

Let the cubic equation $x^3-px^2+qx-r=0$ be proposed, and let it be transformed, by assuming $y=x-e$, into the equation

$$\left.\begin{array}{l} y^3+3ey^2+3e^2y+e^3 \\ -py^2-2pey-pe^2 \\ \quad +qy+qe \\ \quad\quad -r \end{array}\right\}=0.$$

Let us suppose e equal successively to the three values of x, beginning with the least value; and because the last term e^3-pe^2+qe-r will vanish in all these suppositions, the equation will have this form,

$$\left.\begin{array}{l} y^2+3ey+3e^2 \\ -py-2pe \\ \quad +q \end{array}\right\}=0;$$

where the last term $3e^2-2pe+q$ is, from the nature of equations, produced of the remaining values of y, or of the excesses of two other values of x above what is supposed equal to e; since always $y=x-e$. Now,

1°. If e be equal to the least value of x, then those two excesses being both positive, they will give a positive product, and consequently $3e^2-2pe+q$ will be, in this case, positive.

2°. If e be equal to the second value of x, then, of those two excesses, one being negative and one positive, their product $3e^2-2pe+q$, will be negative.

3°. If e be equal to the third and greatest value of x, then the two excesses being both negative, their product $3e^2-2pe+q$ is positive. Whence,

If in the equation $3e^2-2pe+q=0$, you substitute successively in the place of e, the three roots of the equation $e^3-pe^2+qe-r=0$, the quantities resulting will successively have the signs $+$, $-$, $+$; and consequently the three roots of the cubic equation are the limits of the roots of the equation $3e^2-2pe+q=0$. That is, the least of the roots of the cubic is less than the least of the roots of the other; the second root of the cubic is a limit between the two roots of the other; and the greatest root of the cubic is the limit that exceeds both the roots of the other.

We have demonstrated, that the roots of the cubic equation $e^3-pe^2+qe-r=0$ are limits of the quadratic $3e^2-2pe+q$; whence it follows *(conversely)* that the roots of the quadratic $3e^2-2pe+q=0$ are the limits between the first and second, and between the second and third roots of the cubic $e^3-pe^2+qe-r=0$. So that if you find the limit that exceeds the greatest root of the cubic, by the beginning of this chapter you will have (with 0, which is the limit less than any of the roots) four limits for the threeroots of the proposed cubic.

It was demonstrated in chap 17. §3. how the quadratic $3e^2-2pe+q$ is deduced from the proposed cubic $e^3-pe^2+qe-r=0$, *viz.* by multiplying each term by the index of e in it, and then dividing the whole by e; and what we have demonstrated of cubic equations is easily extended to all others; so that we conclude " that the " last term but one of the transformed equation is the " equation for determining the limits of the proposed " equation." Or, that the equation arising by multiplying each term by the index of the unknown quantity in it, is the equation whose roots give the limits of the proposed equation; if you add to them the two mentioned in p. 109. col. 2. par. 4.

For the same reason, it is plain that the root of the simple equation $3e-p=0$, (*i. e.* $\frac{1}{3}p$) is the limit between the two roots of the quadratic $3e^2-2pe+q=0$. And, as $4e^3-3pe^2+2qe-r=0$ gives three limits of the equation $e^4-pe^3+qe^2-re+s=0$, so the quadratic $6e^2-3pe+q=0$ gives two limits that are betwixt the roots of the cubic $4e^3-3pe^2+2qe-r=0$; and $4e-p=0$ gives one limit that is betwixt the two roots of the quadratic $6e^2-3pe+q=0$. So that we have a complete series of these equations arising from a simple equation to the proposed, each of which determines the limits of the following equation.

If two roots in the proposed equation are equal, then " the limit that ought to be betwixt them must, " in this case, become equal to one of the equal roots " themselves." Which perfectly agrees with what was demonstrated in the last chapter, concerning the rule for finding the equal roots of equations.

And, the same equation that gives the limits, giving also one of the equal roots, when two or more are equal, it appears, that " if you substitute a limit in place of " the unknown quantity in an equation," and, instead of a positive or negative result, it be found $=0$, then you may conclude, that " not only the limit itself is a root " of the equation, but that there are two roots in that " equation equal to it and to one another."

It having been demonstrated, that the roots of the equation $x^3-px^2+qx-r=0$ are the limits of the roots of the equation $3x^2-2px+q=0$, the three roots of the cubic equation, which suppose to be a, b, c, substituted for x in the quadratic $3x^2-2px+q$, must give the results positive and negative alternately. Suppose these three results to be $+N$, $-M$, $+L$; that is, $3a^2-2pa+q=N$, $3b^2-2pb+q=-M$, $3c^2-2pc+q=L$; and since $a^3-pa^2+qa-r=0$, and $3a^3-2pa^2+qa=N\times a$, subtracting the former multiplied into 3 from the latter, the remainder is $pa^2-2qa+3r=N\times a$. In the same manner $pb^2-2qb+3r=-M\times b$, and $pc^2-2qc+3r=+L\times c$. Therefore $px^2-2qx+3r$ is such a quantity, that if, for x, you substitute in it successively a, b, c, the results will be $+N\times a$, $-M\times b$, $+L\times c$. Whence a, b, c, are limits of the equation $px^2-2qx+3r=0$, by p. 109. col. 2. par. 8. and, *conversely*, the roots of the equation $px^2-2qx+3r=0$ are limits between the first and second, and between the second and third roots of the cubic $x^3-px^2+qx-r=0$. Now the equation $px^2-2qx+3r=0$ arises

rifes from the propofed cubic by multiplying the terms of this latter by the arithmetical progreffion o, —1, —2, —3. And, in the fame manner, it may be fhewn that the roots of the equation $px^3-2qx^2+3rx-4s=0$ are limits of the equation $x^4-px^3+qx^2-rx+s=0$.

Or, multiply the terms of the equation

$$x^3-px^2+qx-r=0$$
$$\text{by } a+3b,\ a+2b,\ a+b,\ a$$

$$ax^3-apx^2+aqx-ar\ (=0)$$
$$+3bx^3-2bpx^2+bqx\ (=\overline{3x^2-2px+q}\times bx.)$$

Any arithmetical feries where a is the leaft term, and b the common difference, and the products (if you fubftitute for x, fucceffively, a, b, c, the three roots of the propofed cubic) fhall be $+N\times bx$, $-M\times bx+L\times bx$. For the firft part of the product $a\times\overline{x^3-px^2+qx-r}=0$; and a, b, c, being limits in the equation $3x^2-2px+q=0$, their fubftitution muft give refults N, M, L, alternately pofitive and negative.

In general, the roots of the equation $x^n-px^{n-1}+qx^{n-2}-rx^{n-3}+$, &c. $=0$ are limits of the roots of the equation $nx^{n-1}-\overline{n-1}\times px^{n-2}+\overline{n-2}\times qx^{n-3}-\overline{n-3}\times rx^{n-4}+$, &c. $=0$; or of any equation that is deduced from it by multiplying its terms by any arithmetical progreffion, $a\mp b$, $a\mp 2b$, $a\mp 3b$, $a\mp 4b$, &c. And, *converfely*, the roots of this new equation will be limits of the propofed equation

$$x^n-px^{n-1}+qx^{n-2}-, \text{ \&c. } =0.$$

" If any roots of the equation of the limits are impoffible, then muft there be fome roots of the propofed " equation impoffible." For as (in p. 110. col. 1. par. 2.) the quantity $3e^2-2pe+q$ was demonftrated to be equal to the product of the exceffes of two values of x above the third fuppofed equal to e; if any impoffible expreffion be found in thofe exceffes, then there will of confequence be found impoffible expreffions in thefe two values of x.

And " from this obfervation rules may be deduced for " difcovering when there are impoffible roots in equa- " tions." Of which we fhall treat afterwards.

Befides the method already explained, there are others by which limits may be determined which the root of an equation cannot exceed.

Since the fquares of all real quantities are affirmative, it follows, that " the fum of the fquares of the roots of " any equation muft be greater than the fquare of the " greateft root." And the fquare root of that fum will therefore be a limit that muft exceed the greateft root of the equation.

If the equation propofed is $x^n-px^{n-1}+qx^{n-2}-rx^{n-3}+$, &c. $=0$, then the fum of the fquares of the roots (p. 103. col. 1. par. 1.) will be p^2-2q. So that $\sqrt[2]{p^2-2q}$ will exceed the greateft root of that equation.

Or if you find, by p. 103. col. 1. par. 4. the fum of the 4th powers of the roots of the equation, and extract the biquadratic root of that fum, it will alfo exceed the greateft root of the equation.

If you find a mean proportional between the fum of the fquares of any two roots, a, b, and the fum of their biquadrates $(a^4+b^4,)$ this mean proportional will be $\sqrt[2]{a^6+a^2b^4+a^4b^2+b^6}$. And the fum of the cubes is a^3+b^3. Now, fince $a^2-2ab+b^2$ is the fquare of $a-b$, it muft be always pofitive; and if you multiply it by a^2b^2, the product $a^4b^2-2a^3b^3+a^2b^4$ will alfo be pofitive; and confequently $a^4b^2+a^2b^4$ will be always greater than $2a^3b^3$. Add a^6+b^6 and we have $a^6+a^4b^2+a^2b^4+b^6$ greater than $a^6+2a^3b^3+b^6$; and extracting the root $\sqrt[2]{a^6+a^4b^2+a^2b^4+b^6}$ greater than a^3+b^3. And the fame may be demonftrated of any number of roots whatever.

Now, if you add the fum of all the cubes taken *affirmatively* to their fum with their *proper* figns, they will give double the fum of the cubes of the affirmative roots. And if you fubtract the fecond fum from the firft, there will remain double the fum of the cubes of the negative roots. Whence it follows, that " half the fum of the " mean proportional betwixt the fum of the fquares " and the fum of the biquadrates, and of the fum " of the cubes of the roots with their proper figns, ex- " ceeds the fum of the cubes of the affirmative roots:" and " half their difference exceeds the fum of the cubes " of the negative roots." And, by extracting the cube root of that fum and difference, you will obtain limits that fhall exceed the fums of the affirmative and of the negative roots. And fince it is eafy, from what has been already explained, to diminifh the roots of an equation fo that they all may become negative but one, it appears how, by this means, you may approximate very near to that root. But this does not ferve when there are impoffible roots.

Several other rules like thefe might be given for limiting the roots of equations. We fhall give one not mentioned by other authors.

In a cubic $x^3-px^2+qx-r=0$, find q^2-2pr, and call it e^4; then fhall the greateft root of the equation always be greater than $\frac{e}{\sqrt[4]{3}}$, or $\sqrt[4]{\frac{e^4}{3}}$. And,

In any equation $x^n-px^{n-1}+qx^{n-2}-rx^{n-3}+$, &c. $=0$, find $\frac{q^2-2pr+2s}{n}$, and extracting the root of the 4th power out of that quantity, it fhall always be lefs than the greateft root of the equation.

Chap. XIX. *Of the Refolution of Equations, all whofe Roots are commenfurate.*

It was demonftrated in chap. 15. that the laft term of any equation is the product of its roots: from which it follows, that the roots of an equation, when commenfurable quantities, will be found among the divifors of the laft term. And hence we have, for the refolution of equations, this

Rule. Bring all the terms to one fide of the equation, find all the divifors of the laft term, and fubftitute them fucceffively for the unknown quantity in the equation. So fhall that divifor which, fubftituted in this manner,

manner, gives the result $=0$, be the root of the proposed equation.

For example, suppose this equation is to be resolved,

$$\left.\begin{array}{l}x^3-3ax^2+2a^2x-2a^2b\\ -bx^2+3abx\end{array}\right\}=0.$$

where the last term is $2a^2b$, whose simple literal divisors are a, b, $2a$, $2b$, each of which may be taken either positively or negatively: but as here we find there are variations of signs in the equation, we need only take them positively. Suppose $x=a$ the first of the divisors, and substituting a for x, the equation becomes

$$\left.\begin{array}{l}a^3-3a^3+2a^3-2a^2b\\ -a^2b+3a^2b\end{array}\right\}\text{ or, } 3a^3-3a^3+3a^2b-3a^2b=0$$

So that, the whole vanishing, it follows, that a is one of the roots of the equation.

After the same manner, if you substitute b in place of x, the equation is

$$\left.\begin{array}{l}b^3-3ab^2+2a^2b-2a^2b\\ -b^3+3ab^2\end{array}\right\}=0,$$

which vanishing, shews b to be another root of the equation.

Again, if you substitute $2a$ for x, you will find all the terms destroy one another so as to make the sum $=0$. For it will then be

$$\left.\begin{array}{l}8a^3-12a^3+4a^3-2a^2b\\ -4a^2b+6a^2b\end{array}\right\}=0.$$

Whence we find, that $2a$ is the third root of the equation. Which, after the first two ($+a$, $+b$,) had been found, might have been collected from this, that the last term being the product of the three roots, $+a$, $+b$, being known, the third must necessarily be equal to the last term divided by the product ab, that is, $=\frac{2a^2b}{ab}=2a$.

Let the roots of the cubic equation

$x^3-2x^2-33x+90=0$ be required.

And first the divisors of 90 are found to be 1, 2, 3, 5, 6, 9, 10, 15, 18, 30, 45, 90. If you substitute 1 for x, you will find $x^3-2x^2-33x+90=56$; so that 1 is not a root of the equation. If you substitute 2 for x, the result will be 24: but, putting $x=3$, you have $x^3-2x^2-33x+90=27-18-99+90=117-117=0$. So that three is one of the roots of the proposed equation. The other affirmative root is $+5$; and after you find it, as it is manifest from the equation, that the other root is negative, you are not to try any more divisors taken positively, but to substitute them, negatively taken, for x: and thus you find, that -6 is the third root. For putting $x=-6$, you have

$x^3-2x^2-33x+90=-216-72+198+90=0$.

This last root might have been found by dividing the last term 90, having its sign changed by 15, the product of the two roots already found.

When one of the roots of an equation is found, in order to find the rest with less trouble, divide the proposed equation by the simple equation which you are to deduce from the root already found, and the quotient shall give an equation of a degree lower than the proposed; whose roots will give the remaining roots required.

As for example, the root $+3$, first found, gave $x=3$, or $x-3=0$, whence dividing thus,

$$\begin{array}{rl}x-3)\ x^3-2x^2-33x+90 & (x^2+x-30\\ x^3-3x^2 & \\ \hline x^2-33x+90 & \\ x^2-3x & \\ \hline -30x+90 & \\ -30x+90 & \\ \hline 0\quad 0 & \end{array}$$

The quotient shall give a quadratic equation $x^2+x-30=0$, which must be the product of the other two simple equations from which the cubic is generated, and whose roots therefore must be two of the roots of that cubic.

Now the roots of that quadratic equation are easily found, by chap. 12. to be $+5$ and -6. For,

$$\begin{array}{ll} & x^2+x=30\\ \text{add } \frac{1}{4} \ldots & x^2+x+\frac{1}{4}=30+\frac{1}{4}=\frac{121}{4}\\ \surd \ldots & x+\frac{1}{2}=\pm\surd\frac{121}{4}=\pm\frac{11}{2}\\ \text{and} \ldots & x=\pm\frac{11}{2}-\frac{1}{2}=+5 \text{ or } -6.\end{array}$$

After the same manner, if the biquadratic $x^4-2x^3-25x^2+26x+120=0$ is to be resolved; by substituting the divisors of 120 for x, you will find, that $+3$, one of those divisors, is one of the roots; the substitution of 3 for x giving $81-54-225+78+120=279-279=0$. And therefore, dividing the proposed equation by $x-3$, you must inquire for the roots of the cubic $x^3+x^2-22x-40=0$, and finding that $+5$, one of the divisors of 40, is one of the roots, you divide that cubic by $x-5$, and the quotient gives the quadratic $x^2+6x+8=0$, whose two roots are -2, -4. So that the four roots of the biquadratic are $+3$, $+5$, -2, -4.

This rule supposes that you can find all the divisors of the last term; which you may always do thus.

"If it is a simple quantity, divide it by its least divi-
"sor that exceeds unit, and the quotient again by its
"least divisor, proceeding thus till you have a quotient
"that is not divisible by any number greater than unit.
"This quotient, with these divisors, are the first or
"*simple divisors* of the quantity. And the products of
"the multiplication of any 2, 3, 4, *&c.* of them are
"the *compound divisors*."

As to find the divisors of 60; first I divide by 2, and the quotient 30 again by 2, then the the next quo- 15 by 3, and the quotient of this division 5 is not farther divisible by any integer above units; so that the simple divisors are,

2, 2, 3, 5;

The products of two, 4, 6, 10, 15.

The products of three, 12, 20, 30.

The product of all four, ... 60.

The divisors of 90 are found after the same manner;

Simple

Simple divisors, 2, 3, 3, 5.
The products of two, 6, 6, 9, 10, 15.
The products of three, . . 18, 30, 45.
The product of all four, ... 90.

The divisors of $21abb$.
The simple divisors, 3, 7, a, b, b.
The products of two, 21, $3a$, $3b$, $7a$, $7b$, ab, bb.
The products of three, $21a$, $21b$, $3ab$, $3bb$, $7ab$, $7bb$, abb.
The products of four, $21ab$, $21bb$, $3abb$, $7abb$.
The products of the five, ... $21abb$.

But as the last term may have very many divisors, and the labour may be very great to substitute them all for the unknown quantity, we shall now shew how it may be abridged, by limiting to a small number the divisors you are to try. And, first, it is plain, from p. 109. col. 1. par. 4. that "any divisor that exceeds the greatest negative coefficient by unity is to be neglected." Thus, in resolving the equation $x^4-2x^3-25x^2+26x+120=0$, as 25 is the greatest negative coefficient, we conclude, that the divisors of 120 that exceed 26 may be neglected.

But the labour may be still abridged, if we make use of the rule in the beginning of ch. 18.; that is, if we find the number which substituted in these following expressions,

$$x^4-2x^3-25x^2+26x+120,$$
$$2x^3-3x^2-25x+13,$$
$$6x^2-6x-25,$$
$$2x-1,$$

will give in them all a positive result: for that number will be greater than the greatest root, and all the divisors of 120 that exceed it may be neglected.

That this investigation may be easier, we ought to begin always with that expression where the negative roots seem to prevail most; as here in the quadratic expression $6x^2-6x-25$; where finding that 6 substituted for x gives that expression positive, and gives all the other expressions at the same time positive, I conclude, that 6 is greater than any of the roots, and that all the divisors of 120 that exceed 6 may be neglected.

If the equation $x^3+11x^2+10x-72=0$ is proposed, the rule of p. 109. col. 1. par. 4. does not help to abridge the operation; the last term itself being the greatest negative term. But, by chap. 18. we inquire what number substituted for x will give all these expressions positive.

$$x^3+11x^2+10x-72$$
$$3x^2+22x+10$$
$$3x+11.$$

Where the labour is very short, since we need only attend to the first expression; and we see immediately that 4 substituted for x gives a positive result, whence all the divisors of 72 that exceed 4 are to be rejected; and thus by a few trials, we find, that $+2$ is the positive root of the equation. Then dividing the equation by $x-2$, and resolving the quadratic equation that is the quotient of the division, you find the other two roots to be -9, and $-$.

But there is another method that reduces the divisors of the last term, that can be useful, still to more narrow limits.

Suppose the cubic equation $x^3-px^2+qx-r=0$ is proposed to be resolved. Transform it to an equation whose roots shall be less than the values of x by unity, assuming $y=x-1$. And the last term of the transformed equation will be $1-p+q-r$; which is found by substituting unit, the difference of x and y, for x, in the proposed equation; as will easily appear from p. 106. col. 1 par. 4. where, when $y=x-e$, the last term of the transformed equation was e^3-pe^2+qe-r.

Transform again the equation $x^3-px^2+qx-r=0$, by assuming $y=x+1$, into an equation whose roots shall exceed the values of x by unit, and the last term of the transformed equation will be $-1-p-q-r$, the same that arises by substituting -1, the difference betwixt x and y, for x, in the proposed equation.

Now the values of x are some of the divisors of r, which is the term left when you suppose $x=0$; and the values of the y's are some of the divisors of $+1-p+q-r$, and of $-1-p-q-r$, respectively. And these values are in arithmetical progression increasing by the common difference unit; because $x-1$, x, $x+1$, are in that progression. And it is obvious the same reasoning may be extended to any equation of whatever degree. So that this gives a general method for the resolution of equations whose roots are commensurable.

Rule. Substitute, in place of the unknown quantity, successively the terms of the progression, 1, 0, -1, &c. and find all the divisors of the sums that result; then take out all the arithmetical progressions you can find among these divisors, whose common difference is unit; and the values of x will be among the divisors arising from the substitutions of $x=0$ that belong to these progressions. The values of x will be affirmative when the arithmetical progression increases, but negative when it decreases.

Examp. Let it be required to find one of the roots of the equation $x^3-x^2-10x+6=0$. The operation is thus;

Suppos.		Result.	Divisors.	Arith. Prog. decr.
$x=1$	$x^3-x^2-10x+6=$	-4	1, 2, 4	4
$x=0$		$+6$	1, 2, 3, 6	3 gives $x=-3$
$x=-1$		$+14$	1, 2, 7, 14	2

Where the suppositions of $x=1$, $x=0$, $x=-1$, give the quantity $x^3-x^2-10x+6$ equal to -4, 6, 14; among whose divisors we find only one arithmetical progression 4, 3, 2; the term of which, opposite to the supposition of $x=0$, being 3, and the series decreasing, we try if -3 substituted for x makes the equation vanish; which

fucceeding one of its roots muft be -3. Then dividing the equation by $x+3$, we find the roots of the (quadratic) quotient $x^2-4x+2=0$ are $2\pm\sqrt{2}$.

If it is required to find the roots of the equation $x^3-3x^2-46x-72=0$, the operation will be thus;

Suppof.	Refults	Divifors.	Progreffions.
$x=1$	-120	1,2,3,4,5,6,8,10,12,15,20,24,30,40,60,120	8 3 4 5
$x=0$	-72	1,2,3,4,6,8,9,12,18,24,36,72.	9 2 3 4
$x=-1$	-30	1,2,3,5,6,10,15,30.	10 1 2 3

Of thefe four arithmetical progreffions having their common difference equal to unit, the firft gives $x=9$, the others give $x=-2$, $x=-3$, $x=-4$; all which fucceed except $x=-3$: fo that the three values of x are $+9$, -2, -4.

CHAP. XX. *Of the Refolution of Equations by finding the Equations of a lower Degree that are their Divifors.*

To find the roots of an equation is the fame thing as to find the *fimple* equations, by the multiplication of which into one another it is produced, or, to find the fimple equations that divide it without a remainder.

If fuch fimple equations cannot be found, yet if we can find the *quadratic* equations from which the propofed equation is produced, we may difcover its roots afterwards by the refolution of thefe quadratic equations. Or, if neither thefe fimple equations, nor thefe quadratic equations can be found, yet, by finding a *cubic* or *biquadratic* that is a divifor of the propofed equation, we may deprefs it lower, and make the folution more eafy.

Now, in order to find the rules by which thefe divifors may be difcovered, we fhall fuppofe, that

$$\left.\begin{matrix} mx-n \\ mx^2-nx+r \\ mx^3-nx^2+rx-s \end{matrix}\right\} \text{are the} \left\{\begin{matrix} \text{fimple} \\ \text{quadratic} \\ \text{cubic} \end{matrix}\right.$$

divifors of the propofed equation; and if E reprefent the quotient arifing by dividing the propofed equation by that divifor, then

$E\times\overline{mx-n}$,

$E\times\overline{mx^2-nx+r}$,

Or, $E\times\overline{mx^3-nx^2+rx-s}$, will reprefent the propofed equation itfelf. Where it is plain, that "fince m is the "coefficient of the higheft term of the divifors, it muft "be a divifor of the coefficient of the higheft term of "the propofed equation."

Next we are to obferve, that, fuppofing the equation has a fimple divifor $mx-n$, if we fubftitute in the equation $E\times\overline{mx-n}$, in place of x, any quantity, as a, then the quantity that will refult from this fubftitution will neceffarily have $ma-n$ for one of its divifors: fince, in this fubftitution, $mx-n$ becomes $ma-n$.

If we fubftitute fucceffively for x, any arithmetical progreffion, a, $a-e$, $a-2e$, &c. the quantities that will refult from thefe fubftitutions will have among their divifors

$ma-n$,

$ma-me-n$,

$ma-2me-n$, which are alfo in arithmetical progreffion, having their common difference equal to me.

If, for example, we fubftitute for x the terms of this progreffion, 1, 0, -1, the quantities that refult have among their divifors the arithmetical progreffion $m-n$, $-n$, $-m-n$; or, changing the figns, $n-m$, n, $n+m$ Where the difference of the terms is m, and the term belonging to the fuppofition of $x=0$ is n.

It is manifeft therefore, that when an equation has any fimple divifor, if you fubftitute for x the progreffion 1, 0, -1, there will be found amongft the divifors of the fums that refult from thefe fubftitutions, one arithmetical progreffion at leaft, whofe common difference will be unit or a divifor m of the coefficient of the higheft term, and which will be the coefficient of x in the fimple divifor required: and whofe term, arifing from the fuppofition of $x=0$, will be n, the other member of the fimple divifor $mx-n$.

From which this rule is deduced for difcovering fuch a fimple divifor, when there is any.

RULE. Subftitute for x in the propofed equation fucceffively the numbers 1, 0, -1. Find all the divifors of the fums that refult from this fubftitution, and take out all the arithmetical progreffions you can find amongft them, whofe difference is unit, or fome divifor of the coefficient of the higheft term of the equation. Then fuppofe n equal to that term of any one progreffion that arifes from the fuppofition of $x=0$, and $m=$ the forefaid divifor of the coefficient of the higheft term of the equation, which m is alfo the difference of the terms of this progreffion; fo fhall you have $mx-n$ for the divifor required.

You may find arithmetical progreffions giving divifors that will not fucceed; but if there is any divifor, it will be found thus by means of thefe arithmetical progreffions.

If the equation propofed has the coefficient of its higheft term $=1$, then it will be $m=1$, and the divifor will be $x-n$, and the rule will coincide with that given in the end of the laft chapter, which we demonftrated after a different manner; for the divifor being $x-n$, the value of x will be $+n$, the term of the progreffion that is a divifor of the fum that arifes from fuppofing $x=0$. Of this cafe we gave examples in the laft chapter; and though it is eafy to reduce an equation whofe higheft term has a coefficient different from unit, to one where that coefficient fhall be unit, by p. 106. col. 1. par. 6.; yet, without that reduction, the equation may be refolved by this rule, as in the following

EXAMP.

Examp. Suppose $8x^3-26x^2+11x+10=0$, and that it is required to find the values of x; the operation is thus;

Suppos.	Results.		Divisors.	Progr.	
$x=1$		$+3$	1, 3.	3	3
$x=0$	$8x^3-26x^2+11x+10=$	$+10$	1, 2, 5, 10.	2	5
$x=-1$		-35	1, 5, 7, 35	1	7

The difference of the terms of the last arithmetical progression is 2, a divisor of 8, the coefficient of the highest term x^3 of the equation, therefore supposing $m=2$, $n=5$, we try the divisor $2x-5$; which succeeding, it follows, that $2x-5=0$, or $x=2\frac{1}{2}$.

The quotient is the quadratic $4x^2-3x-2=0$, whose roots are $\frac{3+\sqrt{41}}{8}$, and $\frac{3-\sqrt{41}}{8}$, so that the three roots of the proposed equation are $2\frac{1}{2}$, $\frac{3+\sqrt{41}}{8}$, $\frac{3-\sqrt{41}}{8}$. The other arithmetical progression gives $x+2$ for a divisor; but it does not succeed.

If the proposed equation has no simple divisor, then we are to inquire if it has not some quadratic divisor (if itself is an equation of more than three dimensions.)

An equation having the divisor mx^2-nx+r may be expressed, as in the first article of this chapter, by $E\times\overline{mx^2-nx+r}$; and if we substitute for x any known quantity a, the sum that will result will have ma^2-na+r for one of its divisors; and, if we substitute successively for x the progression a, $a-e$, $a-2e$, $a-3e$, &c. the sums that arise from this substitution will have

$$ma^2-na+r$$
$$m\times\overline{a-e}^2-n\times\overline{a-e}+r$$
$$m\times\overline{a-2e}^2-n\times\overline{a-2e}+r$$
$$m\times\overline{a-3e}^2-n\times\overline{a-3e}+r,$$
&c.

among their divisors respectively.

These terms are not now, as in the last case, in arithmetical progression; but if you subtract them from the squares of the terms a, $a-e$, $a-2e$, $a-3e$, &c. multiplied by m a divisor of the highest term of the proposed equation, that is from

$$ma^2$$
$$m\times\overline{a-e}^2$$
$$m\times\overline{a-2e}^2$$
$$m\times\overline{a-3e}^2,$$ &c. the remainders,

$$na-r$$
$$n\times\overline{a-e}-r$$
$$n\times\overline{a-2e}-r$$
$$n\times\overline{a-3e}-r,$$ &c. shall be in arithmetical progression, having their common difference equal to $n\times e$.

If, for example, we suppose the assumed progression a, $a-e$. $a-2e$, $a-3e$, &c. to be 2, 1, 0, -1, the divisors will be

$$4m-2n+r$$
$$m-n+r$$
$$+r$$
$$\overline{m+n+r},$$ which subtracted from $4m$, m, 0, m, leave

$$2n-r$$
$$n-r$$
$$-r$$
$$-n-r,$$ an arithmetical progression whose difference is $+n$; and whose term, arising from the substitution of 0 for x, is $-r$.

From which it follows, that by this operation, if the proposed equation has a quadratic divisor, you will find an arithmetical progression that will determine to you n and r, the coefficient m being supposed known; since it is unit, or a divisor of the coefficient of the highest term of the equation. Only you are to observe, that if the first term mx^2 of the quadratic divisor is negative, then in order to obtain an arithmetical progression, you are not to subtract, but add the divisors $-4m-2n+r$, $-m-n+r$, $+r$, $-m+n+r$, to the terms $4m$, m, 0, m.

The general *rule* therefore, deduced from what we had said, is,

" Substitute in the proposed equation for x the terms
" 2, 1, 0, -1, *&c.* successively. Find all the divisors
" of the sums that result, adding and subtracting them
" from the squares of these numbers 2, 1, 0, -1, *&c.*
" multiplied by a numerical divisor of the highest term
" of the proposed equation, and take out all the arith-
" metical progressions that can be found amongst these
" sums and differences. Let r be that term in any
" progression that arises from the substitution of $x=0$,
" and let $\mp n$ be the difference arising from subtracting
" that term from the preceding term in the progression;
" lastly, let m be the foresaid divisor of the highest
" term; then shall $\overline{mx^2\pm nx\mp r}$ be the divisor that
" ought to be tried." And one one or other of the divisors found in this manner will succeed, if the proposed equation has a quadratic divisor.

Chap. XXI. *Of the Methods by which you may approximate to the Roots of* Numerical *Equations by their Limits.*

When any equation is proposed to be resolved, first find the limits of the roots (by chap. 17.) as for example, if the roots of the equation $x^2-16x+55=0$ are required, you find the limits are 0, 8, and 17, by p. 110. col. 2. par. 2.: that is, the least root is between 0 and 8, and the greatest between 8 and 17.

In order to find the first of the roots, I consider, that if I substitute 0 for x in $x^2-16x+55$, the result is positive, *viz.* $+55$, and consequently any number betwixt 0 and 8 that gives a positive result, must be less than the least root, and any number that gives a negative result must be greater. Since 0 and 8 are the limits, I try 4, that is, the mean betwixt them, and supposing $x=4$, $x^2-16x+55=16-64+55=7$, from which I conclude that the root is greater than 4. So that now we have the root limited between 4 and 8. Therefore

I

I next try 6, and substituting it for x we find $x^2-16x+55=36-96+55=-5$; which result being negative, I conclude that 6 is greater than the root required, which therefore is limited now between 4 and 6. And substituting 5, the mean between them, in place of x, I find $x^2-16x+55=25-80+55=0$; and consequently 5 is the least root of the equation. After the same manner you will discover 11 to be the greatest root of that equation.

Thus by diminishing the greater, or increasing the lesser limit, you may discover the true root when it is a commensurable quantity. But, by proceeding after this manner, when you have two limits, the one greater than the root, the other lesser, that differ from one another but by unit, then you may conclude the root is *incommensurable*.

We may however, by continuing the operation in fractions, approximate to it. As if the equation proposed is $x^2-6x+7=0$, if we suppose $x=2$, the result is $4-12+7=-1$, which being negative, and the supposition $x=0$ giving a positive result, it follows that the root is between 0 and 2. Next we suppose $x=1$; whence $x^2-6x+7=1-6+7=+2$, which being positive, we infer the root is betwixt 1 and 2, and consequently incommensurable. In order to approximate to it, we suppose $x=1\frac{1}{2}$, and find $x^2-6x+7=2\frac{1}{4}-9+7=\frac{1}{4}$; and this result being positive, we infer the root must be betwixt 2 and $1\frac{1}{2}$. And therefore we try $1\frac{3}{4}$, and find $x^2-6x+7=\frac{49}{16}-\frac{42}{4}+7=3\frac{1}{16}-10\frac{8}{16}+7=-\frac{7}{16}$, which is negative; so that we conclude the root to be betwixt $1\frac{3}{4}$ and $1\frac{1}{2}$. And therefore we try next $1\frac{5}{8}$, which giving also a negative result, we conclude the root is betwixt $1\frac{1}{2}$ (or $1\frac{8}{16}$) and $1\frac{5}{8}$. We try therefore $1\frac{9}{16}$, and the result being positive, we conclude that the root must be betwixt $1\frac{9}{16}$ and $1\frac{5}{8}$, and therefore is nearly $1\frac{19}{32}$.

Or you may approximate more easily by transforming the equation proposed into another whose roots shall be equal to 10, 100, or 1000 times the roots of the former, by p. 106. col. 1. par. 4. and taking the limits greater in the same proportion. This transformation is easy; for you are only to multiply the 2d term by 10, 100, or 1000, the 3d term by their squares, the 4th by their cubes, &c. The equation of the last example is thus transformed into $x^2-600x+70000=0$, whose roots are 100 times the roots of the proposed equation, and whose limits are 100 and 200. Proceeding as before, we try 150, and find $x^2-600x+70000=22500-90000+70000=2500$, so that 150 is less than the root. You next try 175, which giving a negative result must be greater than the root: and thus proceeding, you find the root to be betwixt 158 and 159: from which you infer, that the least root of the proposed equation $x^2-6x+7=0$ is betwixt 1.58 and 1.59, being the hundredth part of the root of $x^2-600x+70000=0$.

If the cubic equation $x^3-15x^2+63x-50=0$ is proposed to be resolved, the equation of the limits will be (by p. 110. col. 2. par. 2.) $3x^2-30x+63=0$, or $x^2-10x+21=0$, whose roots are 3, 7; and by substituting 0 for x, the value of $x^3-15x^2+63x-50$ is negative; and by substituting 3 for x, that quantity becomes positive. $x=1$ gives it negative, and $x=2$ gives it positive, so that the root is between 1 and 2, and therefore incommensurable. You may proceed as in the foregoing examples to approximate to the root. But there are other methods by which you may do that more easily and readily; which we proceed to explain.

When you have discovered the value of the root to be less than an unit (as, in this example, you know it is a little above 1), suppose the difference betwixt its real value and the number that you have found nearly equal to it, to be represented by f: as in this example. Let $x=1+f$. Substitute this value for x in the equation, thus,

$$\begin{aligned} x^3 &= 1+3f+3f^2+f^3 \\ -15x^2 &= -15-30f-15f^2 \\ +63x &= 63+63f \\ -50 &= -50 \\ \hline x^3-15x^2+63x-50 &= -1+36f-12f^2+f^3=0. \end{aligned}$$

Now because f is supposed less than unit, its powers f^2, f^3, may be neglected in this approximation; so that assuming only the two first terms, we have $-1+36f=0$, or $f=\frac{1}{36}=.027$; so that x will be nearly 1.027.

You may have a nearer value of x by considering, that seeing $-1+36f-12f^2+f^3=0$, it follows that

$$f=\frac{1}{36-12f+f^2}=\text{(by substituting } \tfrac{1}{36} \text{ for } f\text{)}$$

$$\text{nearly}=\frac{1}{36-12\times\frac{1}{36}+\frac{1}{36}\times\frac{1}{36}}=\frac{1296}{46225}=.02803.$$

But the value of f may be corrected and determined more accurately, by supposing g to be the difference betwixt its real value and that which we last found nearly equal to it. So that $f=.02803+g$. Then by substituting this value for f in the equation $f^3-12f^2+36f-1=0$, it will stand as follows,

$$\left.\begin{aligned} f^3 &= 0.0000220226+0.002357g+0.08409g^2+g^3 \\ -12f^2 &= -.00942816 \quad -0.67272g-12g^2 \\ +36f &= 1.00908 \quad +36g \\ -1 &= -1. \end{aligned}\right\}=0$$

$$=-0.0003261374+35.329637g-11.9195g^2+g^3=0.$$

Of which the first two terms, neglecting the rest, give $35.329637\times g=0.0003261374$, and $g=\frac{.0003261374}{35.329637}=0.00000923127$. So that $f=0.02803923127$; and $x=1+f=1.02803923127$; which is very near the true root of the equation that was proposed.

If still a greater degree of exactness is required, suppose h equal to the difference betwixt the true value of g and

and that we have already found, and proceeding as above you may correct the value of g.

It is not only one root of an equation that can be obtained by this method, but, by making use of the other limits, you may discover the other roots in the same manner. The equation of p. 116. col. 2. par. 1. $x^3-15x^2+63x-50=0$, has for its limits 0, 3, 7, 50. We have already found the least root to be nearly 1.028039. If it is required to find the middle root, you proceed in the same manner to determine its nearest limits to be 6 and 7; for 6 substituted for x gives a positive, and 7 a negative result. Therefore you may suppose $x=6+f$, and by substituting this value for x in that equation, you find $f^3+3f^2-9f+4=0$, so that $f=\frac{4}{9}$ nearly. Or, since $f=\frac{4}{9-3f-f^2}$, it is (by substituting $\frac{4}{9}$ for f) $f=\frac{4}{9-\frac{4}{3}-\frac{16}{81}}=\frac{324}{605}$, whence $x=6+\frac{324}{605}$ nearly. Which value may still be corrected as in the preceding articles. After the same manner you may approximate to the value of the highest root of the equation.

" In all these operations, you will approximate sooner " to the value of the root, if you take the three last " terms of the equation, and extract the root of the " quadratic equation consisting of these three terms."

Then, in p. 116. col. 2. par. 2. instead of the two last terms of the equation $f^3-12f^2+36f-1=0$, if you take the three last, and extract the root of the quadratic $12f^2-36f+1=0$, you will find $f=.028031$, which is much nearer the true value than what you discover by supposing $36f-1=0$.

It is obvious that this method extends to all equations.

" By assuming equations affected with general coeffi- " cients, you may, by this method, deduce general " rules or theorems for approximating to the roots of " proposed equations of whatever degree."

CHAP. XXII. *Of the Rules for finding the Number of impossible Roots in an Equation.*

THE number of *impossible* roots in an equation may, for most part, be found by this

RULE. Write down a series of fractions whose denominators are the numbers in this progression, 1, 2, 3, 4, 5. &c. continued to the number which expresses the dimension of the equation. Divide every fraction in the series by that which precedes it, and place the quotients in order over the middle terms of the equation. And, if the square of any term multiplied into the fraction that stands over it gives a product greater than the rectangle of the two adjacent terms, write under the term the sign +, but if that product is not greater than the rectangle, write —; and the signs under the extreme terms being +, there will be as many *imaginary* roots as there are changes of the signs from + to —, and from — to +.

Thus, the given equation being $x^3+px^2+3p^2x-q=0$, I divide the second fraction of the series $\frac{1}{1}, \frac{1}{2}, \frac{1}{3}$, by the first, and the third by the second, and place the quotients $\frac{1}{2}$ and $\frac{2}{3}$, over the middle terms in this manner,

$$\begin{array}{cccc} & \frac{1}{3} & \frac{1}{3} & \\ x^3+ & px^2+ & 3p^2x- & q=0 \\ + & - & + & + \end{array}$$

Then because the square of the second term multiplied into the fraction that stands over it, that is, $\frac{1}{3}\times p^2x^4$, is less than $3p^2x^4$ the rectangle under the first and third terms, I place under the second term the sign —: but as $\frac{1}{3}\times 9p^4x^2$ $(=3p^4x^2)$ the square of the third term multiplied into its fraction is greater than *nothing*, and consequently much greater than $-pqx^2$, the negative product of the adjoining terms, I write under the third term the sign +. I write + likewise under x^3 and $-q$ the first and last terms; and finding in the signs, thus marked, two changes, one from + to —, and another from — to +, I conclude the equation has two impossible roots.

When two or more terms are wanting in the equation, under the first of such terms place the sign —, under the second +, under the third —, and so on alternately; only when the two terms to the right and left of the deficient terms have contrary signs, you are always to write the sign + under the last deficient term.

As in the equations

$$\begin{array}{cccccc} x^5+ & ax^4 & * & * & * & +a^5=0 \\ + & + & - & + & - & + \end{array}$$

$$\text{and}\quad \begin{array}{cccccc} x^5+ & ax^4 & * & * & * & -a^5=0 \\ + & + & - & + & + & + \end{array}$$

the first of which has *four* impossible roots, and the other *two*.

Hence too we may discover if the imaginary roots lie hid among the affirmative, or among the negative roots. For the signs of the terms which stand over the signs below that change from + to —, and — to +, shew, by the number of their variations, how many of the impossible roots are to be reckoned affirmative; and that there are as many negative imaginary roots as there are repetitions of the same sign.

As in the equation

$$\begin{array}{cccccc} x^5- & 4x^4+ & 4x^3- & 2x^2- & 5x- & 4=0 \\ + & + & - & + & + & + \end{array}$$

the signs (— + —) of the terms $-4x^4+4x^3-2x^2$ which stand over the signs + — + pointing out two affirmative roots, we infer that two impossible roots lie among the affirmative: and the three changes of the signs in the equation (+ — + — — —) giving three affirmative roots and two negative, the five roots will be one real affirmative, two negative, and two imaginary affirmatives. If the equation had been

$$\begin{array}{cccccc} x^5- & 4x^4- & 4x^3- & 2x^2- & 5x- & 4=0 \\ + & + & - & - & + & + \end{array}$$

the terms $-4x^4-4x^3$ that stand over the first variation + —, shew by the repetition of the sign —, that one imaginary root is to be reckoned negative, and the

terms $-2x^2-5x$ that ſtand over the laſt variation $-+$, give, for the ſame reaſon, another negative impoſſible root; ſo that the ſigns of the equation ($+-----$) giving one affirmative root, we conclude that of the four negative roots two are imaginary.

This always holds good, unleſs, which ſometimes may happen, "there are more impoſſible roots in the "equation than are diſcoverable by the rule."

ALGENEB, a fixed ſtar of the ſecond magnitude on the right ſhoulder of Perſeus. See PERSEUS.

ALGHER, or ALGERI, a city on the north-weſt coaſt of the iſland of Sardinia, ſituated in E. long. 8° 40′, and N. lat. 41° 30′.

ALGIABARII, among the Mahometans, the name of a ſect of predeſtinarians. See PREDESTINATION.

ALGIERS, a kingdom of Africa, ſituated between 30° and 37° of N. lat. and between 1° W. and 9° E. long. It is bounded by the Mediterranean on the north, by the kingdom of Tunis on the eaſt, by mount Atlas on the ſouth, and by the river Mulvia, which ſeparates it from the empire of Morocco, on the weſt; extending 600 miles, from eaſt to weſt, along the Babary coaſt.

The Turks, who are maſters of this kingdom, are but few in number in compariſon of the Moors, or natives, who have no ſhare in the government. The Arabs, who live in tents, are diſtinct from either. The dey of Algiers is an abſolute, though an elective monarch. He is choſen by the Turkiſh ſoldiers only, and is frequently depoſed, or even put to death by them.

ALGIERS is alſo the name of the capital of the abovementioned kingdom, ſituated near the mouth of the the river Safran, on the Mediterranean ſea, oppoſite to the iſland of Majorca; its E. long. being 3° 27′, and its N. lat. 36° 49′.

ALGOIDES, in botany. See ZANNICHELLIA.

ALGOL, the name of a fixed ſtar of the third magnitude in the conſtellation Perſeus, otherwiſe called Meduſa's head. See ASTRONOMY, *Of the fixed ſtars.*

ALGONQUIN, one of the two principal languages ſpoken in N. America, *viz.* from the river of St Laurence to that of Miſſiſſippi; the other which is called Haron, being ſpoken in Mexico.

ALGOR, with phyſicians, an unuſual coldneſs in any part of the body.

ALGORITHM, and arabic word expreſſive of numerical computation. See ARITHMETIC, Chap. I.

ALGOSAREL, in botany, an obſolete name of the daucus. See DAUCUS.

ALGUAZIL, in the Spaniſh policy, an officer whoſe buſineſs it is to ſee the decrees of a judge executed.

ALHAGI, in botany, the trivial name of a ſpecies of hedyſarum. See HYDESARUM.

ALHAMA, a ſmall town of Granada in Spain, ſurrounded with hills, and ſituated about twenty-five miles S. W. of Granada, W. long. 4°, N. lat. 37°.

ALHANDAL, among Arabian phyſicians, a name uſed for colocynth. See COLOCYNTH.

ALHEAL, in botany. See GALEOPSIS, STACHYS.

ALHENNA, in botany, a ſynonime of the Lawſonia. See LAWSONIA.

ALHIDADE, or ALIDADE, a term of Arabic origin, ſignifying the index or diopter of a mathematical inſtrument for taking heights and diſtances. See DIOPTER.

ALJAMEIA, the name by which the Moriſcoes of Spain called the Spaniſh language.

ALICANT, a large ſea-port town of Spain, in the province of Valencia, with a very ſtrong caſtle. It is ſituated in W. long. 36′, and N. lat. 38° 37′.

ALICATA, a mountain of Sicily, near the valleys Mazara and Noto, upon which was ſituated (as is generally thought) the famous Dædalion, where the tyrant Phalaris kept his brazen bull.

ALICE, a cape of the Hither Calabria in the kingdom of Naples, called in Latin *Alicium promontorium.*

ALICES, an obſolete name of the ſpots that precede the eruption of the ſmall-pox.

ALICULA, in Roman antiquity, a kind of chlamys worn by children, which ſome call *tunica manicata.*

ALICUR, a very ſmall iſland in the Tuſcan ſea, about fifteen miles weſt from the Lipari, on the coaſt of Sicily.

ALIDADE. See ALHIDADE.

ALIDES, among the Mahometans, a deſignation given to the deſcendents of Ali; between whom and the Ommiades, there was a warm diſpute about the kaliphate. See KALIPHATE.

ALJEMBUT, in botany, an obſolete name of a ſpecies of mimoſa. See MIMOSA.

ALIBI, in Scots law; when a perſon purſued for the commiſſion of a crime, libelled to have been committed at a certain place, and upon a certain day, proves in his defence, that he was elſewhere at the time libelled, he is ſaid to have proved *alibi.* See LAW, tit. *Crimes.*

ALIEN, in Scots law, a perſon who owes allegiance to a foreign prince; and who, on that account, cannot hold any feudal right in Scotland without being naturalized. See LAW, title, *Conſtitution of heritable rights.*

ALIEN-*duty*, an impoſt laid on all goods imported by aliens, over and above the cuſtoms paid for ſuch goods imported by Britiſh, and on Britiſh bottoms.

ALIEN-*priories*, a kind of inferior monaſteries, formerly very numerous in England, and ſo called from their belonging to foreign abbeys.

ALIENABLE, denotes ſomething that may be alienated. See ALIENATION.

ALIENATION, in law, denotes the act of making over a man's property in land, tenements, *&c.* to another perſon.

ALIE-

ALIENATION, in mortmain, is making over lands, tenements, *&c.* to a body politic, or to a religious houſe, for which the king's licence muſt firſt be obtained, otherwiſe the lands, *&c.* alienated will be forfeited. See MORTMAIN.

ALIFANUS, in botany, a ſynonime of the rhexia. See RHEXIA.

ALIFORMIS, in anatomy, the name of a pair of muſcles. See ANATOMY, Part II.

ALIFORMIS *proceſſus*, the name given by ſome to the prominencies of the os cuneiforme. See ANATOMY, Part I.

ALIMA, a kind of ſand found in gold mines, of which they make lead.

ALIMENT, whatever promotes the growth or nouriſhment of animal or vegetable bodies. See FOOD.

Obligation of ALIMENT, in Scots law, the natural obligation on parents to provide their children with the neceſſaries of life, *&c.* See LAW, titles, *Marriage*, and *Obligations and contracts in general.*

ALIMENTARY, an epithet for every thing that belongs to aliment or food.

ALIMENTARY *debt*, in Scots law, an obligation come under by one perſon to pay a certain ſum annually for the maintenance of another, either gratuitouſly, in conſideration of a ſum of money ſunk, or by way of wages. See LAW, title, *Arreſtment and poinding.*

ALIMENTARY *children*, in Roman antiquity, an apellation given to thoſe educated in houſes not unlike our hoſpitals.

ALIMENTARY *law*, among the Romans, that whereby children were obliged to maintain their aged parents.

ALIMENTATION, a term uſed by ſome writers, particularly Lord Bacon, for what is commonly called nutrition. See NUTRITION.

ALIMONY, in law. See *Obligation of* ALIMENT.

ALIMOS, in botany, an obſolete name of the glycirrhiza. See GLYCIRRHIZA.

ALIOS-BATON, in ichthyology, an obſolete name of a ſpecies of rana or frog. See RANA.

ALIPILARIUS, or ALIPILUS, in Roman antiquity, a ſervant belonging to the baths, whoſe buſineſs it was, by means of waxen plaſters, and an inſtrument called *volſella*, to take off the hairs from the arm-pits, and even arms, legs, *&c.* this being deemed a point of cleanlineſs.

ALIPTA, in Grecian antiquity. See IATRALIPTRA.

ALIPTERIUM, in the ancient gymnaſia, the ſame with elæotheſium. See ELÆOTHESIUM.

ALIPOW *montis ceti*, a kind of white turbith, found in Languedoc, uſed as a purgative. See TURBITH.

ALIQUANT *parts*, thoſe parts which one number cannot meaſure. See ARITHMETIC.

ALIQUOT *parts*, thoſe parts which one number can meaſure. See ARITHMETIC.

ALISE, or ALIZE, a ſmall town of France, in the diſtrict of Auxois.

ALISE, or ELISE, is a ſmall iſland in the Iriſh ſea, not far from the mull of Galloway.

ALISMA, in botany, a genus of the hexandria polygynia claſs. The characters of the aliſma are theſe. The calix conſiſts of three pieces or leaves; the flower has three petals; and the ſeeds are numerous. There are ſeven ſpecies of this plant, *viz.* the plantago, or great water-plantain, which grows in all the marſhy parts of this country; the ranunculoides, or leſſer water-plantain; the natans, or creeping water-plantain; the damaſonium, or ſtar-headed water-plantain; all of which are natives of Britain: the flava, cordifolia, and ſubulata, are natives of America.

ALITES, in Roman antiquity, a deſignation given to ſuch birds as afforded matter of auguries by their flight; in which ſenſe they are contradiſtinguiſhed from thoſe called *oſcines*. See OSCINES.

ALIZE, in geography. See ALISE.

ALKA, in ornithology. See ALCA.

ALKAHEST, or ALCAHEST, in chemiſtry, an univerſal menſtruum capable of reſolving all bodies into their firſt principles. Van Helmont pretended he was poſſeſſed of ſuch a menſtruum; but, however credulous people might be impoſed on in his days, the notion is now become as ridiculous as the philoſophers ſtone, the perpetuum mobile, *&c.* It is likewiſe uſed by ſome authors for all fixed ſalts volatilized.

ALKAHESTIC, an epithet applied to all powerful menſtruums.

ALKALI, in chemiſtry, a name for all ſubſtances which ferment with acids. See CHEMISTRY, *Of Alkalis, or alkaline ſubſtances.* Alkali originally ſignified only the ſalt of the kali.

ALKALINE, an epithet for every body which poſſeſſes any of the qualities of an alkali.

ALKALIZATION, in chemiſtry, the impregnating any liquor with alkaline bodies.

ALKALY. See ALKALI.

ALKANET, in botany, the Engliſh name of the anchuſa. See ANCHUSA.

ALKEKENGI, in botany, a ſynonime of ſeveral ſpecies of the atropa and phyſalis; it is alſo the trivial name of a ſpecies of the phyſalis. See PHYSALIS, and ATROPA.

ALKERMES, in pharmacy, a compound cordial medicine made in the form of a confection. The principal ingredient is the kermes. See KERMES.

ALKIN, a city of Arabia Felix, ſeven days journey, S. from Mecca.

ALKOOL. See ALCOHOL.

ALKY *of lead*, a ſweet ſubſtance obtained by the chemiſts from lead.

ALL-HALLOWS, the ſame with All-ſaints. See the next article

ALL-SAINTS, a feſtival obſerved by moſt denominations of Chriſtians, in commemoration of all the ſaints in general. It is kept on the firſt of November.

ALL-SAINTS *bay*, or *baiha de todos ſanctos*, a ſpacious harbour near St Salvador in Brazil, in S. America, on the Atlantic Ocean, W. long. 40°, S. lat. 12°.

ALL-SOULS, a feſtival kept in commemoration of all the faithful deceaſed, on the ſecond of November.

ALLA, or ALLAH, the name by which all the profeſſors of Mahometaniſm call the Supreme Being.

The term alla is Arabic, derived from the verb *alah*, to

to adore. It is the ſame with the Hebrew *eloah*, which ſignifies the *adorable Being*.

ALLANTOIS, or ALLANTOIDES, a gut-ſhaped veſicle inveſting the fœtus of cows, goats, ſheep, *&c.* filled with a liquor conveyed to it from the urachus.

ALLAY. See ALLOY.

ALLEGATA, in Roman antiquity, a kind of ſubſcription uſed by the emperors, importing the writings to be verified.

ALLEGATION, in matters of literature, is the quoting an author in regard to the ſubject in hand.

ALLEGIANCE, in law, denotes the obedience which every ſubject owes to his lawful ſovereign.

Oath of ALLEGIANCE, in the Britiſh policy, that taken in acknowledgment of the king as a temporal prince; as the oath of ſupremacy acknowledges him for the ſupreme head of the church.

ALLEGORICAL, a term applied to whatever belongs to, or partakes of, the nature of an allegory. See ALLEGORY.

ALLEGORIST, one who deals in allegories: ſuch were many of the Chriſtian fathers.

ALLEGORY, in compoſition, conſiſts in chuſing a ſecondary ſubject, having all its properties and circumſtances reſembling thoſe of the principal ſubject, and deſcribing the former in ſuch a manner as to repreſent the latter. The principal ſubject is thus kept out of view, and we are left to diſcover it by reflection. In other words, an allegory is, in every reſpect, ſimilar to an hieroglyphical painting, excepting only that words are uſed inſtead of colours. Their effects are preciſely the ſame: An hieroglyphic raiſes two images in the mind; one ſeen, that repreſents one that is not ſeen: An allegory does the ſame; the repreſentative ſubject is deſcribed; and the reſemblance leads us to apply the deſcription to the ſubject repreſented.

There cannot be a finer or more correct allegory than the following, in which a vineyard is made to repreſent God's own people the Jews

"Thou haſt brought a vine out of Egypt; thou "haſt caſt out the heathen, and planted it. Thou "didſt cauſe it to take deep root, and it filled the "land. The hills were covered with its ſhadow, and "the boughs thereof were like the goodly cedars. "Why haſt thou then broken down her hedges, ſo "that all that paſs do pluck her? The boar out of "the wood doth waſte it, and the wild beaſt doth de-"vour it. Return, we beſeech thee, O God of hoſts: "look down from heaven, and behold, and viſit this "vine and the vineyard thy right hand hath planted, "and the branch thou madeſt ſtrong for thyſelf." Pſal. lxxx.

Nothing gives greater pleaſure than an allegory, when the repreſentative ſubject bears a ſtrong analogy, in all its circumſtances, to that which is repreſented. But moſt writers are unlucky in their choice, the analogy being generally ſo faint and obſcure, as rather to puzzle than to pleaſe. Allegories, as well as metaphors and ſimilies, are unnatural in expreſſing any ſevere paſſion which totally occupies the mind. For this reaſon, the following ſpeech of Macbeth is juſtly condemned by the learned author of the Elements of Criticiſm:

Methought I heard a voice cry, Sleep no more!
Macbeth doth murther Sleep; the innocent ſleep;
Sleep that knits up the ravell'd ſleeve of Care,
The birth of each day's life, ſore Labour's bath,
Balm of hurt minds, great Nature's ſecond courſe,
Chief nouriſher in life's feaſt. Act ii. Sc. 3.

ALLEGRO, in muſic, an Italian word, denoting that the part is to be played in a ſprightly, briſk, lively, and gay manner.

Piu ALLEGRO, ſignifies, that the part it is joined to ſhould be ſung or played quicker; as

Poco piu ALLEGRO, intimates, that the part to which it refers, ought to be played or ſung only a little more briſkly than allegro alone requires.

ALLEGRET. See ALEGRETTE.

ALLELENGYON, in antiquity, a tax paid by the rich for the poor, when abſent in the army.

ALLELOPHAGI, a term uſed by ſome authors for a kind of flies which are ſaid to feed upon each other.

ALLELUJAH, in botany, an obſolete name for the oxys. See OXYS.

ALLELUJAH, among eccleſiaſtical writers. See HALLELUJAH.

ALLEMAND, a ſort of grave ſolemn muſic, with good meaſure, and a ſlow movement. It is alſo a briſk kind of dance, very common in Germany and Switzerland

ALLEMANNIC, in a general ſenſe, denotes any thing belonging to the ancient Germans. Thus, we meet with Allemannic hiſtory, Allemannic language, Allemannic law, *&c.*

ALLENDORF, a little city in the Landgravate of Heſſe-Caſſel in Germany, ſituated upon the river Weſer; E. long. 10°, N. lat. 51° 30′

ALLER, a river which runs through the Dutchy of Lunenburg, and falls into the Weſer, a little below Verden.

ALLER, or ALDER, a term uſed in our old writers to denote the ſuperlative degree. Thus, *aller-good* ſignifies the greateſt good

ALLERION, or ALERION, in heraldry, a ſort of eagle without beak or feet, having nothing perfect but the wings. They differ from martlets by having their wings expanded, whereas thoſe of the martlet are cloſe; and denote imperialiſts vanquiſhed and diſarmed; for which reaſon they are more common in French than in German coats of arms.

ALEU, or ALLODE. See ALLODIAL, and ALLODIUM.

ALLEVIARE, in old records, ſignifies to levy or raiſe an accuſtomed fine or impoſition.

ALLEVIATION, is the act of making a thing lighter, or more eaſy to be borne.

ALLEVEURE, a ſmall braſs Swediſh coin, worth about $2\frac{1}{4}d.$ Engliſh money.

ALLEY, in gardening, a ſtraight parallel walk, bounded on both ſides with trees, ſhrubs, *&c.* and uſually covered with gravel or turf.

Covered

Covered ALLEY, that over which the branches of trees meeting, form a ſhade.

ALLEY *of compartment*, that which divides the ſquares of a parterre. See PARTERRE.

ALLEY, among builders, denotes a narrow paſſage leading from one place to another

ALLEY, in perſpective, that which, in order to have a greater appearance of length, is made wider at the entrance than at the termination

ALLIANCE, in the civil and canon law, the relation contracted between two perſons or two families by marriage.

ALLIANCE is alſo uſed for a treaty entered into by ſovereign princes and ſtates, for their mutual ſafety and defence.

In this ſenſe, alliances may be diſtinguiſhed into ſuch as are offenſive, whereby the contracting parties oblige themſelves jointly to attack ſome other power; and into defenſive ones, whereby they bind themſelves to ſtand by and defend each other, in caſe they are attacked by others.

ALLIANCE, in a figurative ſenſe, is applied to any kind of union or connection: thus we ſay, there is an alliance between the church and ſtate.

ALLIGATI, in Roman antiquity, the baſeſt kind of ſlaves, who were uſually kept fettered. See SLAVE.

ALLIER, a river of France, which, ariſing in Languedoc, waters part of Auvergne and Bourbonnois, and falls into the Loire, a little below Nevers.

ALLIGATION.

ALLIGATION, the name of a method of ſolving all queſtions that relate to the mixture of one ingredient with another. Though writers on arithmetic generally make alligation a branch of that ſcience; yet, as it is plainly nothing more than an application of the common properties of numbers, in order to ſolve a few queſtions that occur in particular branches of buſineſs, we chuſe rather to keep it diſtinct from the ſcience of arithmetic.

Alligation is generally divided into *medial* or *alternate*.

I. ALLIGATION MEDIAL.

Alligation medial, from the rates and quantities of the ſimples given, diſcovers the rate of the mixture.

RULE. As the total quantity of the ſimples,
To their price or value;
So any quantity of the mixture,
To the rate.

EXAMP. A grocer mixeth 30 ℔. of currants, at 4 d. *per* ℔. with 10 ℔. of other currants, at 6 d. *per* ℔: What is the value of 1 ℔. of the mixture. *Anſ.* $4\frac{1}{2}$ d.

lb.	*d.*		*d.*
30,	at 4	amounts to	120
10,	at 6	————	60
40			180

lb. *d.* *lb.* *d.*
If 40 : 180 : : 1 : $4\frac{1}{2}$

Note 1. When the quantity of each ſimple is the ſame, the rate of the mixture is readily found by adding the rates of the ſimples, and dividing their ſum by the number of ſimples, thus.

Suppoſe a grocer mixes ſeveral ſorts of ſugar, and of each an equal quantity, *viz.* at 50 s. at 54 s. and at 60 s. *per* C^{wt}. the rate of the mixture will be 54 s. 8 d. *per* C^{wt}.; for,

s. s. d.
50+54+60=164, and 3)164(54 8

Note 2. If it be required to increaſe or diminiſh the quantity of the mixture, ſay, As the ſum of the given quantities of the ſimples, to the ſeveral quantities given; ſo the quantity of the mixture propoſed, to the quantities of the ſimples ſought.

Note 3. If it be required to know how much of each ſimple is in an aſſigned portion of the mixture, ſay, As the quantity of the mixture, to the ſeveral quantities of the ſimples given; ſo the quantity of the aſſigned portion, to the quantities of the ſimples ſought. Thus,

Suppoſe a grocer mixes 10 ℔. of raiſins, with 30 ℔. of almonds, and 40 ℔. of currants, and it be demanded, how many ounces of each ſort are found in every pound, or in every ſixteen ounces of the mixture, ſay,

oz.
80 : 10 : : 16 : 2 raiſins.
80 : 30 : : 16 : 6 almonds.
80 : 40 : : 16 : 8 currants.

Proof 16

Note 4. If the rates of two ſimples, with the total value and total quantity of the mixture be given, the quantity of each ſimple may be found as follows, *viz.* multiply the leſſer rate into the total quantity, ſubtract the product from the total value, and the remainder will be equal to the product of the exceſs of the higher rate above the lower, multiplied into the quantity of the higher-priced ſimple; and conſequently the ſaid remainder, divided by the difference of the rates, will quote the ſaid quantity. Thus,

Suppoſe a grocer has a mixture of 400 ℔ weight, that coſt him 7 l. 10 s. conſiſting of raiſins, at 4 d. *per* ℔. and

and almonds at 6 d. how many pounds of almonds were in the mixture?

```
                         lb.     Rates.
                         400     6 d.
L. s.   d.                 4     4 d.
7 10=1800                ----    ----
     1600               1600 d.  2 d.
     ----                                     L. s.
   2)200(100 ℔. of almonds at 6 d. is,        2 10
     And 300 ℔. of raiſins, at 4 d. is,       5  0
     ----                                     ----
     Total 400                          Proof 7 10
```

II. Alligation Alternate.

Alligation alternate, being the converſe of alligation medial, from the rates of the ſimples, and rate of the mixture given, finds the quantities of the ſimples.

R U L E S.

I. Place the rate of the mixture on the left ſide of a brace, as the root; and on the right ſide of the brace ſet the rates of the ſeveral ſimples, under one another, as the branches.

II. Link or alligate the branches, ſo as one greater, and another leſs than the root may be linked or yoked together.

III. Set the difference betwixt the root and the ſeveral branches, right againſt their reſpective yoke-fellows. Theſe alternate differences are the quantities required.

Note 1. If any branch happen to have two or more yoke-fellows, the difference ketwixt the root and theſe yoke-fellows muſt be placed right againſt the ſaid branch, one after another, and added into one ſum.

Note 2. In ſome queſtions, the branches may be alligated more ways than one; and a queſtion will always admit of ſo many anſwers, as there are different ways of linking the branches.

Alligation alternate admits of three varieties, *viz.* 1. The queſtion may be unlimited, with reſpect both to the quantity of the ſimples, and that of the mixture. 2. The queſtion may be limited to a certain quantity of one or more of the ſimples. 3. The queſtion may be limited to a certain quantity of the mixture.

Variety I.

When the queſtion is unlimited, with reſpect both to the quantity of the ſimples, and that of the mixture, this is called *Alligation Simple.*

Examp. A grocer would mix ſugars, at 5 d. 7 d. and 10 d. *per* ℔. ſo as to ſell the mixture or compound at 8 d. *per* ℔: What quantity of each muſt he take?

$$8\left\{\begin{array}{l}5\\7\\10\end{array}\right.\begin{array}{l}2\\2\\3,\ 1\end{array}\left|\begin{array}{l}lb.\\2\\2\\4\end{array}\right.$$

Here the rate of the mixture 8 is placed on the left ſide of the brace, as the root; and on the right ſide of the ſame brace are ſet the rates of the ſeveral ſimples, *viz.* 5, 7, 10, under one another, as the branches; according to Rule I.

The branch 10 being greater than the root, is alligated or linked with 7 and 5, both theſe being leſs than the root; as directed in Rule II.

The difference between the root 8 and the branch 5, *viz.* 3, is ſet right againſt this branch's yoke-fellow 10. The difference between 8 and 7 is likewiſe ſet right againſt the yoke-fellow 10. And the difference betwixt 8 and 10, *viz.* 2, is ſet right againſt the two yoke-fellows 7 and 5; as preſcribed by Rule III.

As the branch 10 has two differences on the right, *viz.* 3 and 1, they are added; and the anſwer to the queſtion is, that 2 ℔. at 5 d. 2 ℔. at 7 d. and 4 ℔. at 10 d. will make the mixture required.

The truth and reaſon of the rules will appear by conſidering, that whatever is loſt upon any one branch is gained upon its yoke-fellow. Thus, in the above example, by ſelling 4 ℔. of 10 d. ſugar at 8 d. *per* ℔. there is 8 d. loſt: but the like ſum is gained upon its two yoke-fellows; for by ſelling 2 ℔. of 5 d. ſugar at 8 d. *per* ℔. there is 6 d. gained; and by ſelling 2 ℔. of 7 d. ſugar at 8 d. there is 2 d. gained; and 6 d. and 2 d. make 8 d.

Hence it follows, that the rate of the mixture muſt always be mean or middle with reſpect to the rates of the ſimples; that is, it muſt be leſs than the greateſt, and greater than the leaſt; otherwiſe a ſolution would be impoſſible. And the price of the total quantity mixed, computed at the rate of the mixture, will always be equal to the ſum of the prices of the ſeveral quantities caſt up at the reſpective rates of the ſimples.

Variety II.

When the queſtion is limited to a certain quantity of one or more of the ſimples, this is called *Alligation Partial.*

If the quantity of one of the ſimples only be limited, alligate the branches, and take their differences, as if there had been no ſuch limitation; and then work by the following proportion.

As the difference right againſt the rate of the ſimple whoſe quantity is given,
To the other differences reſpectively;
So the quantity given,
To the ſeveral quantities ſought.

Examp. A diſtiller would, with 40 gallons of brandy at 12 s. *per* gallon, mix rum at 7 s. *per* gallon, and gin at 4 s. *per* gallon: How much of the rum and gin muſt he take, to ſell the mixture at 8 s. *per* gallon?

$$8\left\{\begin{array}{l}12\\7\\4\end{array}\right.\begin{array}{l}1,\ 4\\4\\4\end{array}\left|\begin{array}{l}5\\4\\4\end{array}\right|\left.\begin{array}{l}\text{Gal.}\\\text{40 of brandy.}\\\text{32 of rum.}\\\text{32 of gin.}\end{array}\right\}\text{Anſ.}$$

The operation gives for anſwer, 5 gallons of brandy, 4 of

4 of rum, and 4 of gin. But the queſtion limits the quantity of brandy to 40 gallons; therefore ſay,

If 5 : 4 :: 40 : 32

The quantity of gin, by the operation, being alſo 4, the proportion needs not be repeated.

Variety III.

When the queſtion is limited to a certain quantity of the mixture, this is called *Alligation Total.*

After linking the branches, and taking the differences, work by the proportion following,

As the ſum of the differences,
To each particular difference;
So the given total of the mixture,
To the reſpective quantities required.

Examp. A vintner hath wine at 3 s. *per* gallon, and would mix it with water, ſo as to make a compoſition of 144 gallons, worth 2 s. 6 d. *per* gallon: How much wine, and how much water muſt he take?

Gal.

$$30\left\{\begin{matrix}36\\0\end{matrix}\right)\begin{matrix}30\\6\end{matrix}\ \Bigg|\ \begin{matrix}120 \text{ of wine.}\\24 \text{ of water.}\end{matrix}\Bigg\}\ \textit{Anſ.}$$

36 | 144 total.

$$120 \times 36 = 4320$$
$$24 \times 0 = 0$$

Proof 144)4320(30

As 36 : 30 :: 144 : 120
As 36 : 6 :: 144 : 24

There being here only two ſimples, and the total of the mixture limited, the queſtion admits but of one anſwer.

ALLIGATOR, in zoology, a ſynonime of the lacerta crocodilus. See Lacerta.

ALLIGATOR-*pear*, in botany. See Pyrus.

ALLIONIA, in botany, a genus of the tetrandria monogynia claſs. The characters of which are: The common calix is oblong, ſimple, and three flowered; the proper calix is above the fruit, and obſolete; the corolla is irregular; and the receptacle without any covering. There are only two ſpecies of the allionia, *viz.* the violacea, and incarnata, both natives of America.

ALLIOTH, a ſtar in the tail of the greater bear, much uſed for finding the latitude at ſea.

ALLIUM garlick, in botany, a genus of the hexandria monogynia claſs. The characters are: The corolla is open, and divided into ſix parts; the ſpatha is multiflorous; the capſule is above the flower; and the flowers are in the form of an umbell. There are no leſs than 37 ſpecies of the allium, only five of which, *viz.* the ampeloprafum, or great round-headed garlick; the arenarium, or broad-leaved mountain-garlick; the vineale, or crow-garlick; the oleraceum, or wild garlick with an herbaceous ſtriated flower; and the urſinum, or ramſon, are natives of Britain. Allium is a powerful diuretic, and, along with honey, has good effects in aſthmas.

ALLOA, a port-town of Scotland, ſituated on the river Forth, remarkable for the coal-mines in its neighbourhood. W. long. 3° 45′, N. lat. 56° 10′.

ALLOCATION denotes the admitting or allowing of an article of an account, eſpecially in the exchequer. Hence,

Allocatione facienda is a writ directed to the lord treaſurer, or barons of the exchequer, commanding them to allow an accountant ſuch ſums as he has lawfully expended in the execution of his office.

ALLOCATO *comitatu*, a new writ of exigent allowed, before any other county court held, on a former not being complied with. See Exigent.

ALLOCUTION, in Roman antiquity, denotes an harangue made by a general to his army, frequently mentioned on ancient medals.

ALLODIAL *goods*, in Scots law, are ſuch as are enjoyed by the owner, independent of any other. Lands are likewiſe ſaid to be allodial, when they are held without the neceſſity of acknowledging a ſuperior. See Law, title, *Conſtitution of heritable rights*.

ALLODIUM, or Alleud, denotes lands which are the abſolute property of their owner, without being obliged to pay any ſervice or acknowledgement whatever to a ſuperior lord.

ALLOGIA, a term found in old writers on military affairs, for winter-quarters.

ALLOM. See Alum.

ALLONGE, in fencing, denotes a thruſt or paſs at the adverſary. See Pass.

ALLOPHYLLUS, in botany, a genus of the octandria monogynia claſs. The characters are: The calix is four leaved; the leaves are globular; the flower conſiſts of four petals, leſs than the calix; and the ſtigma is forked. There is only one ſpecies, which is found in Zeylon.

ALLOTTING, or Allotment *of goods*, in commerce, is the dividing a ſhip's cargo into ſeveral parts, which are to be purchaſed by ſeveral perſons, whoſe names being written upon as many ſlips of paper, are applied by an indifferent perſon to the ſeveral lots; by which means the goods are divided without partiality, each man having the parcel upon which his name is fixed.

ALLOWANCES, at the cuſtom houſe, to goods rated by weight, are two, *viz.* draught and tare. See Draught and Tare.

ALLOY, or Allay, a proportion of a baſer metal mixed with a finer one. Thus all gold coin has an alloy of ſilver and copper, as ſilver coin has of copper alone; the proportion in the former caſe, for ſtandard gold, being two carrats of alloy in a pound troy of gold;

gold; and, in the latter, eighteen penny-weight of alloy for a pound of filver.

ALLUM. See ALUM.

ALUMNIOR, in fome of our old ftatutes, a perfon whofe trade it is to colour, or paint upon paper or parchment.

ALLUSION, in rhetoric, a figure by which fomething is applied to, or underftood of another, on account of fome fimilitude between them.

ALLUVION, in law, denotes the gradual increafe of land along the fea-fhore, or on banks of rivers. See LAW, title, *Divifion of rights*.

ALLY, in matters of polity, a fovereign prince or ftate that has entered into alliance with others. See ALLIANCE.

ALMACANTARS. See ALMUCANTARS.

ALMACARRON, a port-town of Spain, in the province of Murcia, at the mouth of the Guadalentin; W. long. 1° 15′, N. lat. 37° 40′.

ALMADE, a town of Spain, in the province of la Mancha, in the kingdom of Caftile, fituated upon the top of a mountain, where are the moft ancient, as well as the richeft filver mines in Europe.

ALMADIE, a kind of canoe, or fmall veffel, about four fathoms long, ufually made of bark, and ufed by the negroes of Africa.

ALMADIE is alfo the name of a kind of long boats, fitted out at Calicut, which are eighty feet in length, and fix or feven in breadth. They are exceeding fwift, and are otherwife called *cathuri*.

ALMAGEST, in matters of literature, is particularly ufed for a collection or book compofed by Ptolemy, containing various problems of the ancients both in geometry and aftronomy.

ALMAGEST is alfo the title of other collections of this kind. Thus, Riccioli has publifhed a book of aftronomy which he calls the New Almageft; and Pluckenet, a book which he calls *Almageftrum Botanicum*.

ALMAGRA, a fine deep red ochre. See OCHRE.

ALMAN-FURNACE, the fame with almond-furnace. See ALMOND.

ALMANAC, in matters of literature, a table containing the kalendar of days and months, the rifing and fetting of the fun, the age of the moon, *&c.*

Regiomontanus is allowed to have been the firft who reduced almanacs to their prefent form.

Conftruction of ALMANACS. The firft thing to be done is, to compute the fun's and moon's place for each day of the year, or it may be taken from fome ephemerides and entered in the almanac; next, find the dominical letter, and, by means thereof, diftribute the kalendar into weeks; then, having computed the time of eafter, by it fix the other moveable feafts; adding the immoveable ones, with the names of the martyrs, the rifing and fetting of each luminary, the length of day and night, the afpects of the planets, the phafes of the moon, and the fun's entrance into the cardinal points of the ecliptic, *i. e.* the two equinoxes and folftices.

ALMANDINE, a name given by ancient naturalifts to the carbuncle. See CARBUNCLE.

ALMANZA, a little town in the province of New Caftile in Spain, remarkable for the defeat of the confederate army by the French, in 1707; W. long. 1° 19′, N. lat. 39°.

ALMARIA, a term found in fome ancient records for the archives of a church, monaftery, and the like.

ALMARIC *herefy*, one broached in France in 1209, the diftinguifhing tenet of which was, That no Chriftian could be faved unlefs he believed himfelf to be a member of Chrift.

ALMEDA, a town in the province of Beira in Portugal; W. long. 9° 40′, N. lat. 38° 40′.

ALMEDIA, a frontier town in the province of Tralos Montes, in Portugal; W. long. 7° 10′, N. lat. 40° 40′.

ALMEHRAB, in the Mahometan cuftoms, a nich in their mofques, pointing towards the kebla or temple of Mecca, to which they are obliged to bow in praying. See KEBLA.

ALMELILETU, a term ufed by Avifenna, for a preternatural heat which fometimes remains after a fever is gone.

ALMENE, in botany, an obfolete name of the lotus. See LOTUS.

ALMENE, in commerce, a weight of two pounds ufed to weigh faffron in feveral parts of the continent of the E. Indies.

ALMENDINE, ALMEMDINE, or ALBANDINE, a fpecies of ruby. See RUBY.

ALMERIA, a fea-port town of Spain in the kingdom of Granada, fituated at the mouth of the river Almoria, or Bolciduy.

ALMERY. See AMBERY.

ALMIGGIM-*wood*, is thought to be that of the Indian pine-tree, which being light and white, was greatly efteemed for making mufical inftruments.

ALMISSA, a city of Dalmatia, fubject to the Venetians, and called by the Sclavonians Omifch.

ALMIZADIR, an obfolete term among chemifts for verdigris, *&c.*

ALMODIA, a kind of very long and narrow boat, ufed in the E. Indies.

ALMOGIZA, a term ufed by Arabian writers for the limb of the aftrolabe. See ASTROLABE.

ALMOIN, or *Frank*-ALMOIN, in law. See *Frank*-ALMOIN.

ALMOND, the fruit of the almond-tree. See AMYGDALUS.

ALMOND-*tree*. See AMYGDALUS.

Egyptian ALMOND, in botany. See BRABEJUM.

ALMOND, in commerce, a meafure by which the Portuguefe fell their oil; twenty-fix almonds make a pipe.

ALMONDS, in anatomy. See AMYGDALÆ.

ALMOND-*furnace*, among refiners, that in which the flags of litharge, left in refining filver, are reduced to lead again, by the help of charcoal.

ALMOND is alfo the name of a fpecies of rock-cryftal, ufed by lapidaries in adorning candlefticks, *&c.* on account of their refemblance to the fruit of that name.

ALMONDBURY, a village in England, in the weft riding of Yorkfhire, fix miles from Hallifax.

ALMONER, an officer appointed to diſtribute alms to the poor.

ALMONRY, Aumbry, Ambry. See Ambry.

ALMS, a general term for what is given out of charity to the poor.

In the early ages of Chriſtianity, the alms of the charitable were divided into four parts; one of which was allotted to the biſhop, another to the prieſts, and a third to the deacons and ſub-deacons, which made their whole ſubſiſtence; the fourth part was employed in relieving the poor, and in repairing the churches.

Alms, alſo denotes lands or other effects left to churches or religious houſes, on condition of praying for the ſoul of the donor. Hence,

Free Alms was that which is liable to no rent or ſervice.

Reaſonable Alms was a certain portion of the eſtates of inteſtate perſons, allotted to the poor.

Alms-*box*, or Alms-*cheſt*, in churches, and hoſpitals, *&c.* a ſtrong box, with a hole or ſlit in the upper part, to receive the alms of the charitably diſpoſed.

Alms-*feoth*, or Almes-*feoth*, a term anciently uſed for Peter's pence. See Peter's Pence.

Alms-*houſe*, a kind of hoſpital for the maintenance of a certain number of poor, aged, or diſabled perſons.

ALMSTAD, a town of Sweden, in the province of Smaland, four miles E. of Chriſtianſtad.

ALMOXARIFARGO, an old duty paid upon the Britiſh woollen manufactures in old Spain: Alſo a duty of $2\frac{1}{2}$ *per cent.* paid in Spaniſh America, upon the exportation of bulls hides in European veſſels.

ALMUCANTARS, in aſtronomy, an Arabic word denoting circles of the ſphere paſſing through the center of the ſun, or a ſtar, parallel to the horizon, being the ſame as parallels of altitude. See *Parallels of* Altitude.

ALMUCIUM, denotes a kind of cover for the head, worn chiefly by monks and eccleſiaſtics: It was of a ſquare form, and ſeems to have given riſe to the bonnets of the ſame ſhape, ſtill retained in univerſities and cathedrals.

ALMUCIA, is ſometimes alſo uſed for the furs, or muffs, worn by the ancient canons on their left arms.

ALMUG-TREE, mentioned in Scripture, is ſuppoſed to be the ſame with that which produces the gum arabic.

ALMUNECAR, a port-town of Granada, in Spain, ſituated upon the Mediterranean: W. long. 3° 45′. N. lat. 36° 40′.

ALMUTAZAPHUS, a magiſtrate of Arragon, whoſe office it was to inſpect meaſures and weights, and ſearch houſes for ſtolen goods.

ALMUTHEN, in aſtrology, the planet which ſurpaſſes the reſt with reſpect to dignities. See Dignity.

ALNABATI, in botany, an obſolete name of the ſiliqua. See Siliqua.

ALNAGE, or Aulnage, in the Engliſh polity, the meaſuring of woollen manufactures with an ell, and the other functions of the alnager.

ALNAGER, in the Engliſh polity, a public ſworn officer, whoſe buſineſs is to examine into the aſſize of all woollen cloth made throughout the kingdom, and to fix ſeals upon them. Another branch of his office is to collect an alnage-duty to the king.

ALNAM, in botany, an obſolete name of the Pulegium. See Pulegium.

ALNEY, a ſmall iſland formed by the branches of the Severn, near Glóceſter, in England; called alſo the Eight.

ALNUS, in botany, a ſynonyme of a ſpecies of betula, or alder-tree. See Betula.

Alnus, in the ancient theatres, that part which was moſt diſtant from the ſtage.

ALNWICK, the county-town of Northumberland, in England, ſituated upon the alne.

ALOA, in Grecian antiquity, a feſtival kept in honour of Ceres by the huſbandmen, and ſuppoſed to reſemble our harveſt-home.

ALOE, in botany, a genus of the hexandria monogynia claſs. The characters are: The corolla is erect, open at the top, and the nectarium at the bottom of it; the filaments of the ſtamina are inſerted in the receptacle, the leaves are thick, ſucculent, and for the moſt part beſet with briſtles; the fruit is oblong and cylindrical, and divided into three cells, which contain flat ſemicircular ſeeds. There are eight ſpecies of the aloe, *viz.* the perfoliata, variegata, diſticha, ſpiralis, viſcoſa, pumila, uvaria, and retuſa, moſt of them natives of Africa. The retuſa, or pearl aloe, is a very beautiful plant. It is ſmaller than moſt of the aloe kind. The leaves are ſhort, very thick, ſharp pointed, and turning down with a large thick end, appear there triangular. The colour of the leaves is a fine green, ſtriped in an elegant manner with white, and frequently tipped with red at the point. The flower-ſtalk, which riſes in the midſt of the leaves, is round, ſmooth, of a purple colour, and generally about eight inches high. When the plant has been properly cultivated, the flowers are ſtriped with green and white; and ſometimes they are entirely white. This aloe is ſingular in not having the bitter reſinous juice with which the leaves of moſt others abound; when a leaf of this ſpecies is cut, what runs from it is watery, colourleſs, and perfectly inſipid. Linnæus ſays that this plant thrives beſt in a clay ſoil, and that it grows wild in the clay-grounds of Africa. See plate XI. fig. 1.

The inſpiſſated juice of the aloe is a ſtimulating cathartic bitter, and is uſed in various forms, for cleanſing the primæ viæ, attenuating and reſolving viſcid juices, for promoting the uterine and hæmorrhoidal fluxes, killing worms, *&c.*

ALOE-WOOD. See Xylo-Aloes.

ALOEDARY, an obſolete name of a purging medicine, whoſe chief ingredient is aloes.

ALOETICS, the name of all medicines whoſe chief ingredient is aloes.

ALOGIANS, in church-hiſtory, a ſect of ancient heretics, who denied that Jeſus Chriſt was the Logos, and conſequently rejected the goſpel of St. John.

ALOGOTROPHIA, among phyſicians, the unequal growth or nouriſhment of any part of the body, as in the rickets.

ALOIDES, in botany, an obfolete name of the ftratiotes. See STRATIOTES.

ALOOF, in fea-language, a word of command from the perfon who conns to the man at the helm, to keep the fhip near the wind, when failing upon a quarter-wind.

ALOPECIA, in medicine, fignifies a falling off of the hair, occafioned either by want of nourifhment, or a bad ftate of the humours. It is alfo ufed by Galen for a change in the colour of the hair.

ALOPECIAS, in zoology, an obfolete name of a fpecies of the fqualus or fhark. See SQUALUS.

ALOPECOPITHECUS, in zoology, an obfolete name of a fpecies of the didelphis. See DIDELPHIS.

ALOPECURUS, or FOX-TAIL GRASS, in botany, a genus of the triandria digynia clafs. The calix is bivalved, and the flower confifts of one hollow valve, with a long awn inferted near the bafe on the back part. There are feven fpecies of the alopecurus, *viz.* the pratenfis, or meadow fox-tail grafs; the bulbofus, or bulbofe fox-tail grafs; the geniculatus, or flote fox-tail grafs; and the myofuroides, or field fox-tail grafs; the above four grow wild in Britain: the agreftis, the monfpelienfis, the paniceus, and the hordeiformis, all natives of France, and the fouthern parts of Europe, except the laft, which is a native of India.

ALOSA, the fhad, or mother of herrings, a fpecies of the clupea. See CLUPEA.

ALOST, a town in the Auftrian Flanders, upon the river Dender, half-way between Bruffels and Ghent.

ALP, in ornithology, an obfolete name of a fpecies of the loxia. See LOXIA.

ALPHA, among grammarians, the name of the firft letter of the greek alphabet, anfwering to our A.

ALPHABET, in matters of literature, the natural or accuftomed feries of the feveral letters of a language. See LANGUAGE, and CHARACTER.

ALPHABET, is alfo ufed for a cypher, or table of the ufual letters of the alphabet, with the correfponding fecret characters, and other blank fymbols intended to render the writing more difficult to be decyphered. See DECYPHERING.

ALPHABETICAL, fomething belonging to, or partaking of the nature of an alphabet. Thus we fay, alphabetical order, method, *&c.*

ALPHENIC, a name fometimes ufed for white barley-fugar, or twifted fugar.

ALPHESERA, in botany, an obfolete name of a fpecies of bryonia. See BRYONIA.

ALPHESTES, in ichthyology, an obfolete name of a fpecies of labrus. See LABRUS.

ALPHETA, in aftronomy, the fame with lucida coronæ. See LUCIDA CORONÆ.

ALPHITIDION, a term for a fracture, wherein the bone is crufhed to pieces.

ALPHITOMANCY, a fpecies of divination, otherwife called aleuromancy. See ALEUROMANCY.

ALPHONSIN, in furgery, an inftrument ufed in extracting bullets, in gun-fhot-wounds. See SURGERY, *Of Gun-fhot wounds.*

ALPHONSINE TABLES, aftronomical tables, calculated by order of Alphonfus king of Caftile, in the conftruction of which that prince is fuppofed to have contributed his own labour.

ALPHOS, among phyficians, a difeafe of the fkin, which is rough, and fprinkled with white fpots.

ALPINE, fomething belonging to the Alps. See ALPS.

ALPINIA, in botany, a genus of the monandria monogynia clafs, of which there is but one fpecies. The flower is tubulous, and divided into fix fegments; the capfule, which becomes a fruit, is divided into three cells, each containing one feed. It is a native of America.

ALPS, a chain of exceeding high mountains, feparating Italy from France and Germany.

ALQUIER, a liquid meafure, ufed in Portugal to meafure oil, two of which make an almond. See ALMOND.

ALRAMECH, in aftronomy, the name of a ftar of the firft magnitude, otherwife called arcturus. See ARCTURUS, and ASTRONOMY.

ALRUM, in botany, an obfolete name of the tree from which the gum bdellium is procured. See BDELLIUM.

ALSACE, a province formerly belonging to Germany, but almoft entirely ceded to France by the peace of Munfter; is fituated between the river Rhine on the eaft, and Lorrain on the weft, Switzerland on the fouth, and the palatinate of the Rhine on the north.

ALSADAF, in materia medica, an obfolete name of the unguis odoratus. See UNGUIS.

ALSAHARATICA, in botany, an obfolete name of the parthenium. See PARTHENIUM.

ALSEN, an ifland in the leffer belt, at the entrance of the Baltic fea, between Slefwic and Funen. E. long. 10° 12′, N. lat. 55° 12′.

ALSCHARCUR, in materia medica. See SKINK.

ALSFIELD, or ASFIELD, a town of Heffe Caffel, in Germany. E. long. 9° 5′. N. lat. 50° 40′.

ALSIMBEL, in botany, an obfolete name of a fpecies of nardus. See NARDUS.

ALSINA, in botany, a fynonyme of the theligonum. See THELIGONUM.

ALSINASTRUM, in botany, the trivial name and alfo a fynonyme of the elatine. See ELATINE.

ALSINE, *Chickweed*, in botany, a genus of the pentandria trigynia clafs: The calix is divided into five parts; the flowers confift of five petals divided in the middle; and the capfule has three valves. There are three fpecies of the alfine, *viz.* the media, or common chickweed, a native of Britain; the mucronata, a native of Switzerland; and the fegetalis, a native of France.

The alfine media has fometimes been recommended in hectical cafes.

ALSIRAT, in the Mahometan theology, denotes a bridge laid over the middle of hell, the paffage or path whereof is fharper than the edge of a fword; over which every body muft pafs at the day of judgement, when the wicked will tumble headlong into hell, whereas the good will fly over it like the wind.

ALSONE, a fmall city of Languedoc in France, upon the river Frefquel, between Carcaffone and St. Papoul.

ALSWANGEN, a town of Livonia, in the dutchy of Courland, ſituated upon the Baltic.

ALT, in muſic, a term applied to the high notes in the ſcale. See Music.

ALTAMURA, a city in the kingdom of Naples, at the foot of the Apennines. E. long. 17°. N. lat. 41°.

ALTAR, a place upon which ſacrifices were anciently offered to ſome deity.

The heathens at firſt made their altars only of turf; afterwards they were made of ſtone, of marble, of wood, and even of horn, as that of Apollo in Delos. Altars differed in figure as well as in materials. Some were round, others ſquare, and others oval. All of them were turned towards the eaſt, and ſtood lower than the ſtatues of the gods, and were generally adorned with ſculpture, inſcriptions, and the leaves and flowers of the particular tree conſecrated to the deity. Thus, the altars of Jupiter were decked with oak, thoſe of Apollo with laurel, thoſe of Venus with myrtle, and thoſe of Minerva with olive.

The height of altars alſo differed according to the different gods to whom they ſacrificed. Thoſe of the celeſtial gods were raiſed to a great height above the ground; thoſe appointed for the terreſtrial, were almoſt on a level with the ſurface of the earth. On the contrary, they dug a hole for the altars of the infernal gods.

Before temples were in uſe, altars were erected ſometimes in groves, ſometimes in the highways, and ſometimes on the tops of mountains; and it was a cuſtom to engrave upon them the name, enſign, or character of the deity to whom they were conſecrated.

In the great temples of ancient Rome, there were ordinarily three altars: The firſt was placed in the ſanctuary, at the foot of the ſtatue of the divinity, upon which incenſe was burnt, and libations offered; the ſecond was before the gate of the temple, and upon it they ſacrificed the victims; and the third was a portable altar, upon which were placed the offering and the ſacred veſſels.

Beſides theſe uſes of altars, the ancients ſwore upon them, and ſwore by them, in making alliances, confirming treaties of peace, and other ſolemn occaſions. Altars alſo ſerved as places of refuge to all thoſe who fled to them, whatever crime they had committed.

Among the Jews, altars in the patriarchal times were very rude. The altar which Jacob ſet up at Bethel was nothing but a ſtone, which ſerved him inſtead of a bolſter; that of Gideon, a ſtone before his houſe; and the firſt which God commanded Moſes to erect was probably of earth, or unpoliſhed ſtones, without any iron; for if any uſe was made of that metal, the altar was declared impure.

The principal altars of the Jews were thoſe of *incenſe*, *of burnt-offering*, and the *altar*, or *table*, *for the ſhew-bread*.

The altar of incenſe was a ſmall table of ſhittim-wood, covered with plates of gold, of one cubit in length, another in width, and two in height.

At the four corners, were four kinds of horns, and all round a little border or crown over it. This was the altar hidden by Jeremiah before the captivity; and upon it the officiating prieſt offered, every morning and evening, incenſe of a particular compoſition. See plate XI. fig. 2.

The altar of burnt-offerings was made of Shittim-wood, and carried upon the ſhoulders of the prieſts by ſtaves of the ſame wood, overlaid with braſs. In the time of Moſes, this altar was five cubits ſquare, and three high; but in Solomon's temple it was much larger, being twenty cubits ſquare, and ten in height. It was covered with braſs; and at each corner was a horn or ſpire wrought out of the ſame wood with the altar, to which the ſacrifices were tied. Within the hollow was a grate of braſs, on which the fire was made; through it fell the aſhes, and were received in a pan below. At the four corners of the grate were four rings, and four chains, which kept it up at the horns. This altar was placed in the open air, that the ſmoke of the burnt-offerings might not ſully the inſide of the tabernacle. See plate XI. fig. 3.

The altar, or table for the ſhew-bread, was likewiſe of ſhittim-wood, covered with plates of gold, having a little border round it, adorned with ſculpture. It was two cubits long, one wide, and one and an half in height. Upon this table, which ſtood in the holy of holies, were put, every ſabbath-day, twelve loaves, with ſalt and incenſe.

The Jewiſh altars, after the return from the captivity, and the building of the ſecond temple, were in ſome reſpects different from thoſe deſcribed above.

That of burnt-offerings was a large pile, built of unhewn ſtones, thirty-two cubits ſquare at the bottom, and twenty-four ſquare at the top. The aſcent was by a gentle riſing, thirty-two cubits in length, and ſixteen in breadth.

Altar is alſo uſed among Chriſtians for the communion-table. See Communion-table.

Altar is ſometimes alſo uſed to denote the offerings made at the altar, in contradiſtinction from the ſettled revenues of a church.

Altar, in aſtronomy. See Ara.

ALTAR-THANE, in old law books, an appellation given to the prieſt or parſon of a pariſh, to whom the altarage belonged. See Altarage.

ALTARAGE, in law, altars erected in virtue of donations, before the Reformation, within a parochial church, for the purpoſe of ſinging of maſs for deceaſed friends. See Scots Law, title, *Eccleſiaſtical perſons*.

Altarage likewiſe ſignifies the profits ariſing to the prieſt on account of the altar.

ALTARIST, the ſame with altar-thane. See Altar-thane.

ALTEA, a ſea-port town of Spain, ſituated upon the Mediterranean, in the province of Valencia, about 45 miles ſouth of the city Valencia, W. lon. 15′. N. lat. 38°. 40′.

ALTEMBURG, a town of Tranſilvania, ſubject to the houſe of Auſtria, ſituated in 23° E. long. and 46° 25′ N. lat.

ALTEMBURG is alſo uſed by ſome for Altenburg. See ALTENBURG.

ALTENA, a port-town of Holſtein, in Germany, ſituted on the river Elbe. It belongs to the Danes, and is the place where all their Eaſt India goods are ſold.

ALTENBURG, a town of Miſnia, in the upper Saxony, about 25 miles S. of Leipſic, and ſubject to the duke of Saxe Altenburg. E. long. 12° 44′, N. lat. 50° 52′.

ALTENBURG-OWAR, a fortified town of lower Hungary, ſituated on the river Danube, and ſubject to the houſe of Auſtria. E. long. 17° 20′, N. lat. 48° 15′.

ALTENSPACH, a city of Germany, in the circle of Swabia, ſituated between the lakes of Conſtance and Zeill.

ALTERANTS, or ALTERATIVE *medicines*, ſuch as correct the bad qualities of the blood and other humours, without occaſioning any ſenſible evacuation.

ALTERATE, in muſic and geometry. See SESQUI.

ALTERATION, in a general ſenſe, denotes ſome variation in the qualities or circumſtances of a thing, without wholly changing its nature.

ALTERATION, in medicine, is particularly uſed to denote the action of alterant medicines. See ALTERANTS.

ALTERCUM, in botany, an obſolete name of the Hyoſciamus. See HYOSCIAMUS.

ALTERDOCHAON, a town of Portugal, in Eſtremadura, three leagues S. W. of Portalegre.

ALTERITY, a term uſed by ſome philoſophers for what is more uſually called diverſity. See DIVERSITY.

ALTERN-BASE, in trigonometry, a term uſed in contradiſtinction to the true baſe. Thus in oblique triangles, the true baſe is either the ſum of the ſides, and then the difference of the ſides is called the altern-baſe; or the true baſe is the difference of the ſides, and then the ſum of the ſides is called the altern-baſe.

ALTERNATE, in a general ſenſe, a term applied to ſuch perſons or things as ſucceed each other by turns. Thus, two who command each his day, are ſaid to have an alternate command, or to command alternately.

ALTERNATE, in heraldry, is ſaid in reſpect of the ſituation of the quarters.

Thus the firſt and fourth quarters, and the ſecond and third, are uſually of the ſame nature, and are called alternate quarters.

ALTERNATE, in botany, when the leaves or branches of plants ariſe higher on oppoſite ſides alternately.

ALTERNATE *angles*. See GEOMETRY.

ALTERNATE *ratio*. See ALGEBRA, and ARITHMETIC.

ALTERNATION, properly ſignifies a ſucceſſion by turns. See ALTERNATE.

ALTHÆA, in botany, a genus of the monadelphia polyandria claſs. The calix of the althæa is double, and the outer one is divided into nine ſegments; and the capſules are numerous, each containing but one ſeed. There are three ſpecies of this genus, *viz.* the officinalis, a native of Britain, the root and leaves of which are ſuppoſed to be balſamic, pectoral and ſtomachic; the cannabina, a native of Hungary; and the hirſuta, a native of France, Italy, *&c.*

ALTINGAR, the name of a flux-powder, uſed in the fuſion of metals. See FLUX, and CHEMISTRY.

ALTIN, a kingdom of Aſia, in great Tartary, between the ſources of the Irtich and the Oby. It is bounded on the north by the Kirgiſes, on the eaſt by the Amaduners, on the ſouth by the kingdom of Eluth, and on the weſt by the Irtich, which ſeparates it from Barabinſkoi.

ALTIN, is alſo the capital of the kingdom of that name, ſituated in the northern part of the kingdom, at the head of the river Kiſam.

ALTIN, in commerce, a kind of money current in Muſcovy, worth three copics.

ALTITH. See ASA-FOETIDA.

ALTITUDE, acceſſible, and inacceſſible. See PRACTICAL GEOMETRY.

ALTITUDE, of a figure, is the neareſt diſtance of its vertex from its baſe, or the length of a perpendicular let fall from the vertex to the baſe.

ALTITUDE in optics, is the height of an object above a line, drawn parallel to the horizon from the eye of the obſerver.

ALTITUDE *of the eye*, in perſpective, is its perpendicular height above the geometrical plane.

ALTITUDE *of a ſtar*, &c. in aſtronomy, is an arch of a vertical circle, intercepted between the ſtar and the horizon. See ASTRONOMY.

ALTITUDE *of motion*, according to Dr Wallis, is its meaſure eſtimated in the line of direction of the moving force.

ALTITUDE, in aſtrology. See EXALTATION.

ALTITUDE *of fluids*, is more uſually expreſſed by the term depth. See DEPTH.

Determinative ALTITUDE, that from whence a heavy body falling, acquires a certain velocity by its natural acceleration.

ALTKIRK, a town of Alſace in Germany, ſituated on the river Ill, in N. lat. 47° 40′, and E. lon. 7° 15′.

ALTMORE, a town of Ireland, in the county of Tyrone, and province of Ulſter, ſituated in N. lat. 54° 34′, and W. long. 7° 2′.

ALTMUL, a river of Germany, which ariſing in Franconia, runs S. E. by the city of Anſpach; and continuing its courſe E. by Pappenheim and Aichſtet, falls into the Danube at Kelheim, about 12 miles above Ratiſbon.

ALTO, and BASSO, in law, denotes the abſolute ſubmiſſion of all differences high and low to ſome arbitrator.

ALTOM, a name given, in ſeveral parts of the Turkiſh dominions, to what the Europeans call a ſequin. See SEQUIN.

ALTO-MONTE, a town of the hither Calabria, in the kingdom of Naples, at the foot of the Apennines, ten miles from Caſſano.

ALTO-RELIEVO. See RELIEVO.

ALTO-

Fig. 1.
ALOE floribus sessilibus bilabiatis
or PEARL ALOE

Fig. 2.
ALTAR of Burnt Offering

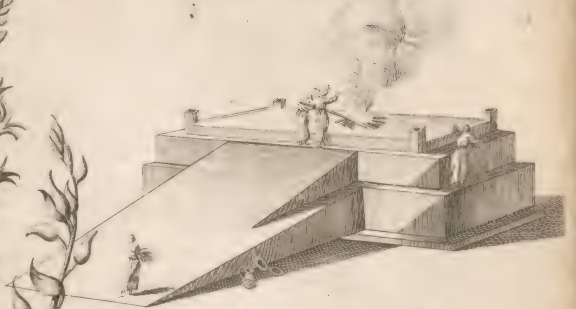
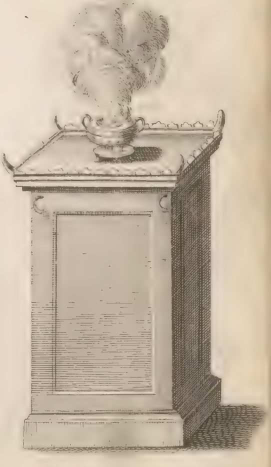


Fig. 3.
ALTAR of Incense



A. Bell Sculpt.

ALTO-RIPIENO, in muſic, the tenor of the great chorus which ſings and plays only now and then in ſome particular places.

ALTORF, a town of Germany, in the circle of Swabia, ſituated in N. lat. 47° 46′, and E. long. 9° 35′.

Altorf, is likewiſe the name of a town in the circle of Franconia, ſituated in N. lat. 49° 20′, and E. long. 11° 20′.

Altorf, is alſo the capital of the canton of Uri, in Switzerland, ſituated on the lake Lucern, in N. lat. 46° 50′, and E. long. 8° 30′.

ALTRINGHAM, a town of Cheſhire in England, upon the borders of Lancaſhire, ſeven miles from Mancheſter.

ALTRIP, a ſmall town of Germany, in the dioceſe of Spire, ſituated upon the Rhine, a little above Manheim.

ALTUMAL, a term ſometimes uſed to denote the mercantile ſtyle or dialect.

ALTUS, in muſic. See Counter-tenor.

ALTZHEIM, or Altzey, a town of Germany, ſituated in N. lat. 49° 45′, and E. long. 7° 52′, about 42 miles N. W. of Heidelberg.

ALVA *de Tormes*, a town of Spain, in the province of Leon, ſituated on the river Tormes, in N. lat. 41°, and W. long. 6°, about 16 miles S. E. of Salamanca.

ALVAH, among the Mahometans, the name by which they call the wood wherewith Moſes ſweetened the waters of Marah.

ALVAHAT, a province of higher Egypt, ſituated under the tropics.

ALVARID, in the hiſtory of Spain, a kind of magiſtrate or judge, differing very little from the alcaid. See Alcaid.

ALVARISTS, in church hiſtory, a branch of Thomiſts, ſo called from Alvares their leader; who aſſerted ſufficient grace, inſtead of the efficacious grace of the ancient Thomiſts. See Thomists.

ALUCO, in ornithology, the trivial name of a ſpecies of ſtrix. See Strix.

ALUDE, a kind of ſheep's leather, one ſide of which has the wool on.

ALUDELS, in chemiſtry, earthen pots ranged one above another, for retaining the flowers which aſcend in the proceſs of ſublimation. The loweſt aludel is fitted to the pot which contains the matter to be ſublimed, and at the top is a cloſe head for collecting the flowers which aſcend higheſt. See Chemistry.

ALVEARIUM, in anatomy, the hollow of the outer ear. See Anatomy, Part VI.

Alvearium, in matters of literature, is uſed in a figurative ſenſe for a collection or theſaurus.

ALVEOLUS, in natural hiſtory, the name of the waxen cells in bee-hives. See Apis.

Alveolus, in anatomy, the ſockets in the jaws wherein the teeth are fixed. See Anatomy, Part I.

Alveolus, in botany, the name of the cells in which the ſeeds of ſeveral plants are ranged.

Alveolus, in natural hiſtory, a ſea foſſile of a conic figure, compoſed of a number of cells, like bee-hives, joined into each other, with a pipe of communication.

ALVEUS, in anatomy, a name ſometimes given to the tumid lacteal veſſels proceeding from the receptaculum chyli.

Alveus, is alſo uſed in Roman antiquity, for a kind of boat, faſhioned out of the trunk of a ſingle tree: Such was that in which Romulus and Remus were expoſed.

ALVIDONA, a town of Calabria, in the kingdom of Naples, upon the gulph of Roſſano.

ALVI *fluxus*, among phyſicians. See Diarrhoea.

Obſtructio Alvi, a Latin phraſe for coſtiveneſs. See Costiveness.

ALVIDUCA, among phyſicians, a term for laxative medicines.

ALUM, or Alumen, in natural hiſtory, a peculiar kind of ſalt, ſometimes found pure, but oftner ſeparated from ſeveral ſubſtances, as a ſoft reddiſh ſtone in Italy, ſeveral kinds of earth, and, in England, from a whitiſh or bluiſh ſtone, called Iriſh ſlate. Alum, in medicine, is a powerful aſtringent. In dying, it fixes the colours upon the ſtuff. See Chemistry.

Proceſs of making Alum. At Whitby, in Yorkſhire, alum is made thus: Having burnt a quantity of the ore with whins, or wood, till it becomes white, then they barrow it in a pit, where it is ſteeped in water for eight or ten hours. This liquor, or lixivium, is conveyed by troughs to the alum-houſe, into ciſterns, and from them into the pans, where it is boiled about 24 hours. They add a certain quantity of the lee of kelp; the whole is drawn off into a ſettler; where having remained about an hour, that the ſulphur and other dregs may have time to ſettle to the bottom, it is conveyed into coolers. This done, to every tun of the liquor they add about eight gallons of urine; and having ſtood four days and nights, till quite cool, the alum begins to cryſtallize on the ſides of the veſſel, from which being ſcraped off, it is waſhed with fair water, and then thrown in a bing, to let the water drain off. After this it is thrown into a pan, called the roching pan, and there melted; in which ſtate it is conveyed by troughs into tuns, where it ſtands about 10 days, till perfectly condenſed. Then ſtaving the tuns, the alum is taken out, chipped, and carried to the ſtore-houſes.

This is what we commonly call roche or rock alum, as being prepared from ſtones cut from the rocks of the quarry; and ſtands contradiſtinguiſhed from the common alum, or that prepared from earths.

Artificial Alum, that prepared by art, in contradiſtinction from the native alum. It is alſo uſed for alum produced by cauſing burnt earthen veſſels imbibe a large quantity of oil of vitriol; the effect of which is, that they are thereby reduced to a mucilage, which, being expoſed to the open air, affords cryſtals of pure alum. Tobacco-pipes, wetted with ſpirit of ſulphur, likewiſe afford beautiful cryſtals of plumoſe alum.

Burnt Alum, is that melted in a fire-ſhovel, or crucible, where it is allowed to bubble till it becomes a white hard ſubſtance.

The watery part of the alum being thus expelled, the

the remainder is left poſſeſſed of all its acids, leſs clogged, and more in a condition to exert its effects. It proves a gentle eſcharotic, and is uſed in ſmall quantities, mixed with other ingredients, in tooth-powders.

Crude ALUM, that which has undergone no other refinement than what it receives at the alum-works.

Native ALUM, or *Foſſile* ALUM, that formed by nature, without the aſſiſtance of art.

There are ſtill mines of native alum in the iſland of Chio, conſiſting of a kind of vaults, or apartments cruſted over with alum, which may be looked upon as exfoliations from the rock.

Plumoſe ALUM, or *Plume* ALUM, a kind of natural alum, compoſed of a ſort of threads, or fibres, reſembling feathers; whence it has its name.

Prepared ALUM, or *Purified* ALM, that which is diſſolved in hot rain-water, and afterwards made to cryſtalize, by evaporating the water.

Roche-ALUM, or *Rock*-ALUM. See the article, *Proceſs of making* ALUM, *ſupra*.

Roman ALUM, a ſort of rock-alum, of a reddiſh colour, made in the country near Rome.

Saccharine ALUM, is a compoſition of common alum with roſe-water, and the whites of eggs, which being boiled to the conſiſtence of a paſte, is formed in the ſhape of a ſugar-loaf; it is uſed as a coſmetic.

Sciſſile ALUM, the ſame with plumoſe alum.

ALUMEN, the Latin name of alum.

ALUMEN *catini*, a name ſometimes uſed for the ſalt of the kali.

ALUMEN *ſcagliolæ*, a name ſometimes uſed for *lapis ſpecularis*.

ALUMINOUS, an epithet for things that partake of the nature of alum.

ALUMTA, in botany. See LUTEOLA.

ALUS, or ALUM, in botany, an obſolete name of the ſymphytum. See SYMPHYTUM.

ALVUS, in anatomy, a term uſed for the belly in general, but more frequently applied to the bowels.

ALWAIDII, a ſect of Mahometans who believe all great crimes to be unpardonable.

ALYPIAS, the name of a kind of white turbith. See TURBITH.

ALPUM, in botany, a ſynonyme and likewiſe the trivial name of a ſpecies of globularia. See GLOBULARIA.

ALYSSOIDES, in botany, a ſynonyme of the alyſſum. See ALYSSUM.

ALYSSUM, or ALYSSON, in botany, a genus of the tetradynamia ſiliculoſa. The flowers of the alyſſum conſiſt of four leaves in the form of a croſs: The capſule is ſhort and ſmooth, and contains a number of roundiſh ſeeds. There are 14 ſpecies of the alyſſum, none of which are natives of Britain.

ALYTARCHA, a prieſt of Antioch in Syria, who, in the games inſtituted in honour of the gods, preſided over the officers who carried rods to clear away the crowd, and keep order.

In the Olympic games, the alytarches had the ſame command, and obliged every perſon to preſerve order and decency.

ALZACHI, in botany, an obſolete name of the anguria. See ANGURIA.

ALZAGI, or ALZEGI. See ZEGI.

ALZARAC, the Arabian name of a coarſe kind of camphor.

ALZIRA, a town of Spain, in the province of Valentia, ſituated on the river Xucar, about 18 miles S. of the city of Valencia, W. long. 20°, N. lat. 39° 10′.

ALZIZ, among Arabian phyſicians. See ZIZ.

ALZUM. See BDELLIUM.

AMA, among eccleſiaſtical writers, denotes a veſſel in which wine or water were kept for the ſervice of the euchariſt.

AMA, is ſometimes alſo uſed for a wine-meaſure, as a pipe, or the like.

AMABYR, or AMVABYR, a cuſtom which formerly prevailed in Wales, and ſome other parts of the kingdom; being a certain fine, or ſum of money, paid to the lord upon marrying a maid within his manor.

AMACACHES, a people of Brazil, in S. America, near the government of Rio Janeiro.

AMACUSA, an iſland of Japan, ſeparated by a narrow ſtrait from Saicoco, or Ximo.

AMACUSA, is alſo the capital of the province of that name.

AMACAO. See MACOA.

AMADABAT, a large populous trading city in the E. Indies, the capital of the province of Guzurat, or Cambay, and ſituated in 72° E. long. and 23° 40′ N. lat.

AMADAN, or HAMADAN, in geography. See HAMADAN.

AMADANAGER, a town in the higher peninſula of India, ſituated in 74° 15′ E. long. and 18° N. lat.

AMADIA, a city of Aſiatic Turky, in the province of Curdeſtan, ſituated on a high mountain, in 43° E. long. and 37° N. lat.

AMAIN, or AMAYNE, in the ſea-language, a term importing to lower ſomething at once. Thus, to ſtrike amain, is to lower, or let fall, the top-ſails; to wave amain, is to make a ſignal, by waving a drawn ſword, or the like, as a demand that the enemy ſtrike their top-ſails.

AMAK, or AMAKA, an iſland of Denmark, lying in 13° 5′ E. long. and 55° 29′ N. lat. and ſeparated by a very narrow channel from Copenhagen.

AMALFA, a city of Italy, in the kingdom of Naples, and province of the hither Principato. It is the ſee of an archbiſhop, and remarkable for giving birth to Flavius Blendus, inventor of the ſeaman's compaſs. E. long. 15° 20′, N. lat. 48° 50′.

AMALGAM, mercury united with ſome metal. See CHEMISTRY.

AMALGAMATION, in chemiſtry, the operation of making an almalgam, or mixing mercury with any metal. See CHEMISTRY.

AMALGAMATION, is alſo uſed by ſome, in a leſs proper ſenſe, for a ſolution of ſulphur with mercury.

AMAN,

AMAN, a port of Africa, in the kingdom of Morocco, upon the Atlantic ocean, between cape Ger, and cape Cantin.

AMAN, is alſo the name of a kingdom, near the middle of the iſland of Sumatra, in the E. Indies.

AMANCE, a town of Lorrain, ſituated in 6° 10′ E. long. and 48° 40′ N. lat. about ſeven miles N. E. of Nancy.

AMAND, or ST AMAND, the name of two towns, one ſituated in the duchy of Bourbon, in the province of Lyonnois in France; and the other in French Flanders, about ſix miles N. of Valenciennes.

AMANTEA, a ſea-port town and biſhop's ſee of the kingdom of Naples, ſituated near the bay of Euphemia, in the province of Calabria, in 16° 20′ E. long. and 39° 15′ N. lat.

AMAPALLA, a ſea-port town of Mexico, in the province of Guatimala, ſituated on the Pacific ocean, in 93° W. long. and 12°30′ N. lat.

AMARACUS, in botany, a ſynonyme of the origanum. See ORIGANUM.

AMARANTA, or AMARANTE, an order of knighthood, inſtituted in 1653, by Chriſtina Queen of Sweden, in memory of a maſquerade, wherein ſhe had aſſumed that name, which ſignifies *unfading*, or *immortal*. Her nobility likewiſe aſſumed different characters, *viz.* of gods, goddeſſes, ſhepherds, nymphs, *&c.* and ſo well pleaſed was the Queen with the diverſion, that ſhe inſtituted this order in memory of it, conſiſting of 16 lords, and as many ladies, with the motto, *Dolce nella memoria.*

AMARANTH, in botany. See AMARANTHUS.

AMARANTHOIDES, in botany, the trivial name of a ſpecies of illecebrum. See ILLECEBRUM.

AMARANTHUS, in botany, a genus of the monœcia pentandria claſs. The flowers have no petals; the calix is multifid; and the ſeeds are contained in membranaceous veſſels, and very numerous. There are 22 ſpecies of amaranthus, none of them natives of Britain, except the blitum, or leſſer blite; all the others are found in the Indies. The amaranthus is ſaid to be aſtringent.

AMARYLLIS, in botany, a genus of the hexandria monogynia claſs. The ſpatha of the amaryllis conſiſts of one leaf, the flower, like other liliaceous plants, has ſix petals, and the ſtigma is trifid. There are 12 ſpecies of the amaryllis, all of them natives of the warm climates. Fig. 1. of plate XII. repreſents the orientalis, a native of the E. Indies.

AMASIA, the northern diviſion of leſſer Aſia, lying on the S. ſhore of the Euxine ſea.

AMASIA, is alſo the name of the capital city of the above province, ſituated in 36° E. long. and 42° N. lat. about 70 miles S. of the Euxine ſea.

AMASTRIS, or AMASTRO, a city of Turky in Aſia, in the province of Breſangil, ſituated on the Black Sea.

AMATIDES, a name uſed by ſome for an incombuſtible ſtone. See AMIANTHUS.

AMATITLAN, a town of N. America, ſituated in the valley of Mixco, in the province of Guatimala.

AMATORII *muſculi*, in anatomy, a term ſometimes uſed for the obliquus ſuperior and obliquus inferior muſcles of the eye, as theſe muſcles aſſiſt in ogling or drawing the eye ſideways. See ANATOMY, part VI.

AMATRICE, a city of the kingdom of Naples, in the farther Abruzzo, upon the confines of the pope's territories, and the marquiſate of Ancona.

AMAUROSIS, in medicine, a diſtemper in the eye, occaſioned by an inſenſibility of the retina. See MEDICINE.

AMAUSA, a term uſed by chemiſts for paſtes counterfeiting gems.

AMAXOBII, the ſame with *hamaxobii*.

AMAZON, in a general ſenſe, denotes a bold daring woman.

AMAZONS, were an ancient nation of women, inhabiting that part of leſſer Aſia now called Amaſia. See AMASIA.

The Amazons are ſaid to have killed all their male children, and to have cut off the right breaſts of their females, to fit them for martial exerciſes. The exiſtence, however, of ſuch a nation is controverted by many judicious authors, and defended by others, particularly Mr Petit, who has publiſhed a diſſertation on the ſubject, wherein are ſeveral curious inquiries concerning their arms, dreſs, *&c.*

We alſo read of Scythian Amazons, of German Amazons, of Lybian Amazons, and Amazons of America, living on the banks of the great river which bears their name, who are repreſented as governed by a queen, no man being permitted to live among them; only, at a certain ſeaſon, thoſe of the neighbouring nations are ſuffered to viſit them for the ſake of procreation. The Amazons of Lybia are famous for their wars with another female nation called Gorgons. See GORGONS.

On medals, the buſt of the Amazons is ordinarly repreſented armed with a little battle-ax, called by the Romans *biceps*, or *ſecuris*, which they carried on their ſhoulder with a ſmall buckler, in form of a half moon, diſtinguiſhed by the name of *pelta*, upon their left arm.

AMAZONS, in a figurative ſenſe, an appellation given to bees, as being governed by a queen.

AMAZON, in geography, a great river in S. America, which riſing in Peru, near the equator, runs caſtward a courſe of more than 3000 miles; and, like other rivers between the tropics, annually overflows its banks, at which ſeaſon it is about 150 miles broad where it falls into the ocean.

AMAZONIAN, denotes ſomething belonging to the amazons.

AMBACHT, a term uſed in ſome parts of Germany and Flanders, for the magiſtracy of a city, or the diſtrict or territory belonging to it.

AMBADAR, a city of Africa, in the upper Ethiopia, ſituated upon the Nile, between the provinces of Darnbea and Savea.

AMBAGES. See CIRCUMLOCUTION.

AMBAMARJAM, or AMBARA, the capital city of Abyſſinia,

Abyssinia, or higher Ethiopia, situated on the side of a lake, out of which the river Nile issues; 35° E. long. and 13° S. lat.

AMBARVALIA, in antiquity, a ceremony among the Romans, when, in order to procure from the gods an happy harvest, they conducted the victims thrice round the corn-fields in procession, before sacrificing them. *Ambarvalia* were either of a private or public nature: the private were performed by the master of a family; and the public by the priests who officiated at the solemnity, called *fratres arvales*. The prayer preferred on this occasion, the formula of which we have in Cato, de Re Rust. cap. cxlii. was called *carmen ambarvale*.

At these feasts they sacrificed to Ceres a sow, a sheep, and a bull, or heifer, whence they take the name of *suovetaurilia*.

The method of celebrating them, was to lead a victim round the fields, while the peasants accompanied it, and one of their number, crowned with oak, hymned forth the praises of Ceres, in verses composed on purpose.

This festival was celebrated twice a-year, at the end of January, according to some, or in April, according to others; and for the second time in the month of July.

AMBARVALIS, in botany, an obsolete name of the polygala. See POLYGALA.

AMBE, in surgery, an instrument for reducing dislocated bones.

AMBE, in anatomy, a term for the superficial jutting out of a bone.

AMBER, *succinum*, or *electrum*, in natural-history, a hard bituminous inflammable substance, brittle, somewhat transparent, generally of a yellowish colour, and when warm sends forth a fragrant bituminous odour. Amber is likewise endowed with an electrical virtue; when rubbed, it attracts straws or other light bodies. The taste of amber is acrid, bituminous, and somewhat astringent. It does not effervesce with acids, and is soluble in spirit of wine and essential oils. When subjected to a chemical analysis, it first yields a subacid water, afterwards a yellow fetid oil, and a volatile salt; what remains in the retort, is a black, light, friable matter, resembling the *bitumen Judaicum*.

Amber is chiefly found in Prussia, and in the Baltic sea, near the shore of Sudavia, where it is found swimming on the surface of the water, and is taken in nets. It is esteemed a powerful medicine in hysteric and hypochondriac cases.—Naturalists are much divided about the origin of amber: Some maintaining it to be an animal substance, others a resinous juice oozing from poplars and firs near the shore, and running into the sea. But it has lately been found to be a true bitumen; the veins of which were discovered, by the Prussians, in the bowels of the earth, in the marsh near Kustrin.

AMBER, in geography, a river, which rising in the S. W. part of Bavaria, runs N. E. by Lansperg and Dachan, and falls into Iser, a little above Landshut.

AMBERG, a fortified town of Bavaria, situated on the river Ils, about 30 miles N. of Ratisbon, in 12° E. long. and 49° 25′ N. lat.

AMBERGREASE, or AMBERGRISE, in natural history, is a solid, opaque, ash-coloured, fat, inflammable substance, variegated like marble, remarkably light, rugged and uneven in its surface, and has a fragrant odour when heated. It does not effervesce with acids; melts freely over a fire, into a kind of yellow rosin, and is hardly soluble in spirit of wine. Ambergrise is greatly used by perfumers on account of its sweet smell. In medicine it is used for nervous complaints. It is found in great quantities in the Indian ocean, near the Molucca isles, as also near Africa, and sometimes near the northern parts of England, Scotland, and Norway. There has been many different hypotheses concerning the origin of ambergrease; but the most probable is that which supposes it to be a fossile bitumen, or naphtha, exsuding out of the bowels of the earth, in a fluid form, and distilling into the sea, where it hardens, and floats on the surface.

AMBERING, a term used by some writers for giving the scent of amber to any thing.

AMBERT, a city of France, in the lower Auvergne, remarkable for its manufactures in paper and camblets.

AMBETTUWAY, in botany, a barbarous name of a tree, the leaves of which, when boiled in wine, are said to create an appetite, and is used by the people in Guinea with that intention.

AMBIAM, a kingdom of Ethiopia, situated between the Nile, and a river which rises out of the lake Zaffan.

AMBIDEXTER, a person who can use both hands with the same facility and for the same purposes that the generality of people do their right hands.

AMBIEGNÆ *oves*, in the heathen sacrifices, an appellation given to such ewes as, having brought forth twins, were sacrificed together with their two lambs, one on each side. We find them mentioned among other sacrifices to Juno.

AMBIENT, a term used for such bodies, especially fluids, as encompass others on all sides: thus, the air is frequently called an ambient fluid, because it is diffused round the earth.

AMBIERLE, a city of France, three leagues from Rouanne, and 15 from Lyons, on the borders of the Lionnois.

AMBIGENAL *hyperbola*, a name given by Sir Isaac Newton to one of the triple hyperbolas of the second order, having one of its infinite legs falling within an angle formed by the assymptotes, and the other without.

AMBIGUITY, in rhetoric and grammar, a defect of language, whereby words are rendered ambiguous. See the next article.

AMBIGUOUS, a term applied to a word or expression which may be taken in different senses.

AMBILLON, a village of France, in Touraine, where there is a great quarry for mill-stones.

AMBIT, in geometry, is the same with what is otherwise

wiſe called the perimeter of a figure. See PERIMETER.

AMBITUS, in Roman antiquity, the ſetting up for ſome magiſtracy or office, and formally going round the city to ſolicit the intereſt and votes of the people. On theſe occaſions, it was not only uſual to ſolicit the intereſt of their friends and others with whom they were perſonally acquainted, but the candidates, being attended by perſons of an extenſive acquaintance, who ſuggeſted to them the names of the citizens, and thence called *nomenclatores*, or *interpretes*, made their application to all they met. This method of ſuing for offices was deemed allowable, and therefore never prohibited by law; but to reſtrain all undue influence, whether by bribery, or exhibiting games, ſhews, and the like, many laws were enacted, and ſevere fines impoſed.

AMBLE, in horſemanſhip, a peculiar pace by which a horſe's two legs of the ſame ſide move at the ſame time.

AMBLETEUSE, a ſmall ſea-port-town of Picardy in France, ſituated about five miles north of Boulogne.

AMBLYGON, in geometry, denotes an obtuſe angled triangle, or a triangle one of whoſe angles conſiſts of more than ninety degrees.

AMBLYOPY. See GUTTA SERENA.

AMBO, or AMBON, in eccleſiaſtical antiquity, a kind of pulpit or reading-deſk, where that part of the divine ſervice called the gradual was performed.

AMBOHETSMENES, a province in the iſland of Madagaſcar, near the mountains of the ſame name.

AMBONUM. See OCULUS BELI.

AMBOINA. See AMBOYNA.

AMBOISE, a town of Orleanois, in France, ſituated on the river Loire, about ten miles eaſt of Tours, in 1° E. long. and 47° 25′ N. lat.

AMBOYNA, an iſland of the E. Indies, lying between the Molucca iſles and thoſe of Banda, in 126° E. long. and 3° 40′ S. lat.

In this iſland, which is about ſeventy miles in circumference, the Dutch have a ſtrong fort, garriſoned by ſeven or eight hundred men. What makes it the more remarkable, is the cruel uſage and expulſion of the Engliſh factors by the Dutch, in the reign of K. James I.

AMBOSINE, a province of Africa, in the kingdom of Benin.

AMBOTE, a town of Poland, in Samogitia, upon the river Wardaria, two Poliſh miles from Siade, and nine from the Baltic ſea.

AMBOULE, a large country in the iſland of Madagaſcar, to the north of Carcanoſſi.

AMBOULE is alſo the name of a conſiderable village in in that country.

AMBOURNAY, a ſmall town of France, upon the river Ain, on the road from Lyons to Geneva.

AMBRA, or AMBRAGRISIA. See AMBERGREASE.

AMBRASI, a river of Africa, which, after waſhing the kingdom of Congo, falls into the Ethiopian Ocean.

AMBRES, a city of France, in the Upper Languedoc, in the dioceſe of Caſtres.

AMBRESBERRY, a market-town in Wiltſhire, about ſix miles north of Saliſbury, and ſituated in 1° 40′ W. long. and 51° 20′ N. lat.

AMBROSE, or *St* AMBROSE *in the wood*, an order of religious, who uſe the Ambroſian office, and wear an image of that ſaint engraven on a little plate: in other reſpects they conform to the rule of the Auguſtins. See AMBROSIAN OFFICE, and AUGUSTINS.

AMBROSIA, in heathen antiquity, denotes the ſolid food of the gods, in contradiſtinction from the drink, which was called *nectar*. It had the appellation *ambroſia*, as being ſuppoſed to render thoſe immortal who fed thereon.

AMBROSIA, is alſo a term for rough or crude wax, ſuppoſed to be the food of bees.

AMBROSIA, in Grecian antiquity, a name ſometimes uſed for a feſtival of Bacchus, otherwiſe called *lenæa*. See LENÆA.

AMBROSIA, in botany, a genus of the monœcia pentandria claſs. The male floſcules of the ambroſia have no petals; the fruit of the female is prickly, and ſhaped like a club, containing one oblong ſeed in each. There are four ſpecies of ambroſia, *viz.* the trifida, elatior, and the artemiſifolia, all natives of America; and the maritima, a native of Greece.

AMBROSIAN *office*, in church-hiſtory, a particular formula of worſhip in the church of Milan, which takes its name from St Ambroſe, who inſtituted that office in the fourth century. Each church originally had its particular office; and when the pope, in after-times, took upon him to impoſe the Roman office upon all the weſtern churches, that of Milan ſheltered itſelf under the name and authority of St Ambroſe; from which time the Ambroſian ritual has prevailed.

AMBROSIN, a coin formerly ſtruck by the dukes of Milan, repreſenting St Ambroſe on horſeback, with a whip in his right hand.

AMBRUN, in geography, the ſame with Embrun. See EMBRUN.

AMBRY, a place in which are depoſited all utenſils neceſſary for houſe-keeping. In the ancient abbeys and priories, there was an office under this denomination, wherein were laid up all charities for the poor.

AMBUBAJÆ, in Roman antiquity, were immodeſt women, who came from Syria to Rome, where they lived by proſtitution, and by playing on the flute.

AMBUBEJA, in botany, an obſolete name of the cichorium. See CICHORIUM.

AMBUILA, or AMBOILA, a country of Africa, in the kingdom of Congo, between the lake Aquelonde and St Salvador.

AMBULATION. See WALKING.

AMBULATION, in ſurgery, a term uſed for the ſpreading of a gangrene or mortification.

AMBULATORY, a term applied to ſuch courts as were not fixed, but removed ſometimes to one place, ſometimes to another.

AMBURBIUM, in Roman antiquity, a proceſſion made by the Romans round the city and pomœrium, in which they

they led a victim, and afterwards facrificed it, in order to avert fome calamity that threatened the city.

AMBURY, or ANBURY, among farriers, denotes a tumor, wart, or fwelling, which is foft to the touch, and full of blood.

This diforder of horfes is cured by tying a horfehair very hard about its root, and, when it has fallen off, which commonly happens in about eight days, ftrewing fome powder of verdegris upon the part, to prevent the return of the complaint. If the tumor be fo low that nothing can be tied about it, they cut it out with a knife, or elfe burn it off with a fharp hot iron; and, in finewy parts, where a hot iron is improper, they eat it away with oil of vitriol, or white fublimate.

AMBUSCADE, or AMBUSH, in the military art, properly denotes a place where foldiers may lie concealed, 'till they find an opportunity to furprife the enemy.

AMBUSTION, with phyficians, the fame with a burn.

AMBY, a town of the Auftrian Netherlands, in the province of Limburg, fituated oppofite to Maeftricht, on the eaft-fide of the river Maefe, in 5° 45′ E. long. and 50° 56′, N. lat.

AMED, or AMIDA, a city of Afia in Mefopotamia: the Arabians call it Diarbeker, and the Turks Kara-Amed.

AMEDEWAT. See AMADABAT.

AMEDIANS, in church-hiftory, a congregation of religious in Italy, fo called from their profeffing themfelves *amantes Deum*, lovers of God; or rather, *amati Deo*, beloved of God.

AMEIVA, in zoology, the trivial name of a fpecies of lacerta. See LACERTA.

AMEL, a term frequently ufed by Mr Boyle, in a fynonimous fenfe with enamel. See ENAMEL.

AMELAND, an ifland of the United Provinces, in the German Ocean, near the coaft of Friezland, from which it is feparated by a ftraight called the Wadt.

AMELBURG, in geography, the fame with Ommenburg. See OMMENBURG.

AMELIA, a city of Italy, fituated on a mountain about fifty miles N. E. of Rome, in 13° 20′ E. long. and 42° 40′ N. lat.

AMELLUS, in botany, a genus of the fyngenefia polygamia fuperflua clafs. The receptacle of the amellus is paleaceous; the calix is fquarrous; and the rays of the corollulæ undivided. There are only two fpecies of this genus, *viz.* the lychnitis, a native of the Cape; and the umbellatus, a native of Jamaica.

AMEN, in the fcripture-language, a folemn formula or conclufion to all prayers, fignifying, *So be it*.

AMEND, or AMENDE, in the French cuftoms, a pecuniary punifhment impofed by a judge for any crime, falfe profecution, or groundlefs appeal.

AMENDE *honorable*, an infamous kind of punifhment inflicted in France upon traitors, parricides, or facrilegious perfons, in the following manner: The offender being delivered into the hands of the hangman, his fhirt is ftripped off, and a rope put about his neck, and a taper in his hand; then he is led into court, where he muft beg pardon of God, the king, the court, and his country. Sometimes the punifhment ends here; but fometimes it is only a prelude to death, or banifhment to the gallies.

AMENDE *honorable* is a term alfo ufed for making recantation in open court, or in prefence of the perfon injured.

AMENDOLARA, a city of the kingdom of Naples, in the Hither Calabria.

AMENDMENT, in a general fenfe, denotes fome alteration or change made in a thing for the better.

AMENDMENT, in law, the correction of an error committed in a procefs, which may be amended after judgment, unlefs the error lies in giving judgment, for in that cafe it is not amendable, but the party muft bring a writ of error.

A bill may be amended on the file at any time before the plea is pleaded; but not afterwards, without motion and leave of the court.

AMENDMENT *of a bill*, in parliament, is fome alteration made in the firft draught of it.

AMENTACEOUS, in botany, an epithet applied to fuch plants as are furnifhed with an amentum. See AMENTUM.

AMENTUM, in botany, the name of a fpecies of calix, confifting of valves, and hanging down in different directions from the caulis. Common oats afford a good example of the amentum.

AMENTUM, in Roman antiquity, a thong tied about the middle of a javelin or dart, and faftened to the fore-finger, in order to recover the weapon as foon as it was difcharged. The ancients made great ufe of the amentum, thinking it helped to inforce the blow. It alfo denotes a latchet that bound their fandals.

AMERADE, the fame with emir. See EMIR.

AMERCEMENT, or AMERCIAMENT, in law, a pecuniary punifhment impofed upon offenders at the mercy of the court.

AMERGO, or MERGO, a city of Africa, in the kingdom of Fez, three leagues from Beni-Tudi.

AMERIA, in geography. See AMELIA.

AMERICA, one of the four parts of the world, and by much the largeft, extending near 9000 miles in length, and about 3000 in breadth. It is fituated between 35° and 145° of W. long. and between 58° S. and 80° N. lat.; bounded by the lands and feas about the arctic pole on the north; by the Atlantic Ocean, which divides it from Europe and Africa on the weft; by the vaft Southern Ocean on the fouth; and by the vaft Pacific Ocean, which divides it from Afia on the eaft. Although it is faid to have taken its name from Americus Vefpucius, a Florentine, it feems indifputable that it was firft difcovered by Chriftopher Columbus, a Genoefe, *anno* 1491; unlefs fome conjectures, much more ancient, be admitted, that it was firft vifited by a Carthaginian fleet, who afterwards fettled in Mexico. It is certain, that its productions, whether animal or vegetable, differ greatly from thofe of any other country; and its original inhabitants, the Efkimaux only excepted, feem to have all the fame original, for they agree in every particular, from Hudfon's Bay, to the Straits of Magellan, excepting only where difference

difference of circumſtances may make ſome diſſimilarity. They have all originally a red copper colour, and every part of their bodies without hair, except the head, where it is black, ſtraight, and coarſe. In the Spaniſh and Portugueſe ſettlements, gold is found in great plenty. Its remarkable rivers are, St Laurence and the Miſſiſippi, in N. America; and the Amazons and Rio de la Plata in S. America. The Andes, which bound Chili on the eaſt, are the higheſt mountains in the world.

AMERICIMA, in zoology, an obſolete name of a ſpecies of lacerta. See LACERTA.

AMERSFORT, a town of the Dutch Netherlands, in the province of Utrecht, ſituated on the river Ems, about fourteen miles north-eaſt of Utrecht, in 5° 20′ E. long. and 52° 25′ N. lat.

AMERSHAM, a market-town of Buckinghamſhire, about twenty-ſeven miles weſtward of London. It is ſituated in 40′ W. long. and 51° 40′ N. lat. and ſends two members to parliament.

AMETHYSTUS, amethyſt, a tranſparent gem of a purple colour, ariſing from a mixture of red and blue. However, their colour is various: Some have a mixture of yellow, and ſome reſemble red wine and water; but the beſt kind is tranſparent and colourleſs, and reſembling ſo much the diamond, that the difference can only be diſtinguiſhed by the ſoftneſs of the amethyſt. This gem is found of various ſizes, from the bulk of a ſmall vetch, to an inch and an half in diameter. Its ſhape is ſometimes roundiſh, ſometimes oblong, and ſometimes flatted a little on one ſide; but its moſt common figure is that of a cryſtal, compoſed of four planes, and terminated by a flat ſhort pyramid. The amethyſt is found in India, Arabia, Armenia, Ethiopia, Cyprus, Germany, Bohemia, and Miſnia; but as they are generally as ſoft as cryſtal, they are not much valued. It may be counterfeited many ways; but the Germans hardly think it worth the counterfeiting.

AMETHYST, in heraldry, a term for the purple colour in the coat of a nobleman, in uſe with thoſe who blazon by precious ſtones, inſtead of metals and colours. This, in a gentleman's eſcutcheon, is called *Purpure*, and in thoſe of ſovereign princes, *Mercury*.

AMETHYSTEA, in botany, a genus of the diandria monogynia claſs, of which there is but one ſpecies, *viz.* the cærulea, a native of the mountains of Siberia. The corolla of this plant is quinquefide, the calix a little bell-ſhaped, and the capſule contains four gibbous ſeeds.

AMETHYSTINE, in a general ſenſe, an appellation given to whatever partakes of the nature, or emulates the colour of the amethyſt.

AMEY, a city of Savoy, ſituated in a plain, upon the lake Nicy.

AMGAILA, or AMGAILAM, an obſolete name of a ſpecies of acanthus. See ACANTHUS.

AMHAR, or AMHARA, a kingdom of Abyſſinia in Africa, ſubject to the great Negus. It is bounded on the north by the kingdom of Bajemder; on the eaſt, by that of Angote; on the ſouth, by the kingdom of Walaca; and on the weſt, by the Nile, which ſeparates it from the kingdom of Gojam. This country is remarkable for the mountains Gheſghen and Ambacel, where the children and near relations of the kings of Abyſſinia were formerly confined; upon which account it is regarded as the native country of the modern emperors.

AMIA, in ichthyology, the trivial name of a ſpecies of ſchomber. See SCHOMBER.

AMIANTHUS, or earth-flax, in natural hiſtory, a fibrous, flexile, elaſtic mineral ſubſtance, conſiſting of ſhort, abrupt, and interwoven filaments. It is found in Germany, in the ſtrata of iron ore, ſometimes forming veins of an inch in diameter. There is another kind of amianthus, which is to be met with in the marble quarries of Wales. But this kind Linnæus affirms to be an aſbeſtos. The amianthus does not give fire with ſteel, nor ferment with acids. It endures an intenſe heat without injury to its texture.

AMICABLE, in a general ſenſe, denotes any thing done in a friendly manner, or to promote peace.

AMICABLE *benches*, in Roman antiquity, were, according to Pitiſcus, lower and leſs honourable ſeats allotted for the *judices pedanei*, or inferior judges, who, upon being admitted of the emperor's council, were dignified by him with the title *amici*.

AMICITIA, or *tenure in* AMICITIA, *tenere in amicitiam*, in the feudal cuſtoms, were lands granted freely to be enjoyed only ſo long as the donor pleaſed.

AMICTUS, in Roman antiquity, was any upper garment worn over the tunica.

AMICTUS, among eccleſiaſtical writers, the uppermoſt garment anciently worn by the clergy; the other five being the alba, ſingulum, ſtola, manipulus, and planeta.

The amictus was a linen garment, of a ſquare figure, covering the head, neck, and ſhoulders, and buckled or claſped before the breaſt. It is ſtill worn by the religious abroad.

AMICULUM, in Roman antiquity, a woman's upper garment, which differed from the pala. It was worn both by matrons and courtezans.

AMICUS *curiæ*, a law-term, to denote a by-ſtander who informs the court of a matter in law that is doubtful or miſtaken.

AMIENS, the capital city of Picardy, in France, ſituated on the river Somme, in E. long. 2° 30′, and N. lat. 49° 50′. It is a beautiful town, and a biſhop's ſee, under the archbiſhop of Rheims. Here too is an univerſity of conſiderable note.

AMIGDALUS, in botany. See AMYGDALUS.

AMIESTIES, cotton cloths, which come from the E. Indies.

AMILICTI, in the ancient Chaldean theology, one of the triads of perſons in the third order of the divine hierarchy. See HIERARCHY.

AMINA, a city of Ethiopia in Africa, nine miles from Albcar.

AMINEUM *cetum*, the name of a vinegar made of the wine of Aminæ, a town of Campania in Italy.

AMIRANTE, in the Spaniſh polity, a great officer of ſtate, anſwering to our lord high-admiral.

AMISIA,

AMISIA, or AMISSA, in geography. See AMASIA.

AMISS, or *drawing* AMISS, among ſportſmen. See DRAWING.

AMISSA, or *lex amiſſa*. See LEX.

AMITTERE *legem terræ*, among lawyers, a phraſe importing the loſs of liberty of ſwearing in any court.

AMMA, in ſurgery. See HAMMA.

AMMA, among eccleſiaſtical writers, a term uſed to denote an abbeſs or ſpiritual mother.

AMMÆA, in geography. See AMED.

AMMAN, or AMMANT, in the German and Belgic policy, a judge who has the cognizance of civil cauſes.

AMMANT, is alſo uſed among the French for a public notary, or officer who draws up inſtruments and deeds.

AMMANNIA, in botany, a genus of the tetrandria monogynia claſs. The corolla conſiſts of four petals inſerted into the calix, which has eight teeth. The capſule has four cells. There are three ſpecies of ammannia, *viz.* the latifolia, and ramoſior, both natives of America; and the baccifera, a native of China.

AMMERGAW, or AMMERLAND, a ſmall territory in Weſtphalia, belonging to the King of Denmark.

AMMI, in botany, a genus of the pentandria digynia claſs. The involucrum is pinnated; and the flowers are all hermophradite, with radiated petals. There are two ſpecies of the ammi, *viz.* the majus and glaucifolium, both natives of Europe.

AMMINIEÆ *uvæ*, a name ſometimes given to a ſpecies of vine. See VITIS.

AMMITES, in natural hiſtory, the name of a congeries of ſtalagmitæ. See STALAGMITÆ.

AMMOCOETUS, in ichthyology. See AMMODYTES.

AMMOCHRYSOS, the name of a ſpecies of mica, a ſtone common in Germany. See MICA.

AMMODYTES, or SAND-EEL, in ichthyology, a genus of fiſhes belonging to the order of apodes. This fiſh reſembles an eel, and ſeldom exceeds a foot in length. The head of the ammodytes is compreſſed, and narrower than the body; the upper jaw is larger than the under; the body is cylindrical, with ſcales hardly perceptible. There is but one ſpecies of the the ammodytes, *viz.* the tobianus, a native of Europe. This fiſh gathers itſelf into a circle, and pierces the ſand with its head in the centre.

AMMON, or HAMMON, in heathen antiquity. See HAMMON.

Cornua AMMONIS, in natural hiſtory. See SNAKE-STONES.

AMMONIAC, the name of a gum-reſin extracted from an African plant. It is tranſported hither in the form of drops or granules, and ſometimes in large maſſes compoſed of theſe granules adhering together. The beſt kind of it is that which is freeſt of droſs, of a yellowiſh colour, and a bitteriſh taſte. It is much uſed in obſtructions of the viſcera and infarctions of the lungs.

Sal AMMONIAC. See ARMONIAC.

AMMONITÆ. See SNAKE-STONES.

AMMUNITION, a general term for all warlike proviſions, but more eſpecially powder, ball, *&c.*

Ammunition, arms, utenſils of war, gun-powder, imported without licence from his Majeſty, are, by the laws of England, forfeited, and triple the value.

And again, ſuch licence obtained, except for furniſhing his Majeſty's public ſtores, is to be void, and the offender to incur a premunire, and to be diſabled to hold any office from the crown.

AMMUNITION *bread*, *ſhoes*, &c. ſuch as are ſerved out to the ſoldiers of an army or garriſon.

AMNA, among ancient phyſicians. See AMNIS.

AMNESTY, in matters of policy, an act by which two parties at variance promiſe to pardon and bury in oblivion all that is paſt.

Amneſty is either general and unlimited, or particular and reſtrained, though moſt commonly univerſal, without condition or exceptions; ſuch as that which paſſed in Germany at the peace of Oſnaburg in the year 1648.

AMNESTY, in a more limited ſenſe, denotes a pardon granted by a prince to his rebellious ſubjects, uſually with ſome exceptions: ſuch was that granted by Charles II. at his reſtoration.

AMNIMODAR, in aſtrology, denotes the planet which rectifies a nativity, or rather the method of doing it.

AMNIOS, in anatomy, a thin pellucid membrane which ſurrounds the fœtus in the womb. See ANATOMY, Part VI.

AMNIS *alcaliſatus*, a term for water impregnated with an alkali. See ALKALI.

AMOER, in geography, the ſame with Amour. See AMOUR.

AMOER is alſo an iſland ſituated eaſt from Niulham, and north-weſt from the land of Yeſſo.

AMNITES. See AMMITES.

AMOEBÆUM, in ancient poetry, a kind of poem, repreſenting a diſpute between two perſons who are made to anſwer each other alternately; ſuch are the third and ſeventh of Virgil's eclogues.

AMOL, a city of Thabariſtan in Aſia upon the Gihun. See GIHUN.

AMOMUM, in botany, a genus of the monandria monogynia claſs. The corolla of the amomum is cut into four ſegments, one of which ſpreads open. There are four ſpecies of this genus, *viz.* the zinziber, zerumbet, cardamom, and grana paradiſi, all natives of the Indies. See CARDAMOM, and GRANA PARADISI.

AMORBACH, a ſmall city of Franconia, in Germany, belonging to the elector of Mentz.

AMORGO, an iſland of the Archipelago, about ninety miles north of Candia, lying in E. long. 26° 15′, and N. lat. 37°.

AMORPHA, in botany, a genus of the diadelphia decandria claſs, of which there is but one ſpecies, *viz.* the fruticoſa. The vexillum of the corolla is ovated and concave; it has no alæ or carina. It is a native of Carolina, and is ſometimes called *barba Jovis Americana.*

AMORTIZATION, in law, the alienation of lands or tenements to a corporation or fraternity and their ſucceſſors. See MORTMAIN.

AMOSSON,

AMOSSON, a river of France, in the province of Languedoc.

AMOVING, the act of expelling a person from his place or office.

AMOUR, a large river of Asia, which, arising in Siberia, runs eastward through Chinese Tartary, and falls into the bay of Corea in the Indian Ocean.

AMOY, an island on the south-west coast of China, situated in E. long. 118°, N. lat. 25°.

AMPANA, in botany, an obsolete name of the borassus. See BORASSUS.

AMPELIS, in botany. See VITIS.

AMPELITES, CANNEL-COAL, a hard, opaque, fossile, inflammable substance, of a black colour. It does not effervesce with acids; it is capable of a fine polish, and for that reason is turned into a number of toys, as snuff-boxes, and the like.

AMPER, or AMPOR, an Essex term for a phlegmon. See PHLEGMON.

AMPEZO, a town in the Tyroleze, belonging formerly to the Venetians, but now to the house of Austria.

AMPHERES, in antiquity, a kind of vessels wherein the rowers plied two oars at the same time, one with the right hand, and another with the left.

AMPHIARTHROSIS, in anatomy, a term for such junctures of bones as have an evident motion, but different from the diarthrosis, *&c.* See DIARTHROSIS.

AMPHIBIA, in zoology, the name of Linnæus's third class of animals, including all those which live partly in water, and partly on land. This class is subdivided into three orders, *viz.* 1. The amphibia reptiles; the amphibia serpentes; and the amphibia nantes. See NATURAL HISTORY.

AMPHIBIOUS, in botany, the same with aquatic. See AQUATIC.

AMPHIBLESTROIDES, in anatomy, a name by which some call the retina of the eye. See RETINA.

AMPHIBOLIA. See the next article.

AMPHIBOLOGY, in grammar and rhetoric, a term used to denote a phrase susceptible of two different interpretations. Amphibology arises from the order of the phrase, rather than from the ambiguous meaning of a word.

AMPHIBRACHYS, in ancient poetry, the name of a foot consisting of three syllables, whereof that in the middle is long, and the other two short; such is the word [ăbīrĕ].

AMPHICTYONS, in Grecian antiquity, an assembly composed of deputies from the different states of Greece, and resembling, in some measure, the diet of the German empire.

The amphictyons met regularly at Delphi twice a-year, *viz.* in spring and autumn, and decided all differences between any of the Grecian states, their determinations being held sacred and inviolable.

AMPHIDROMIA, in antiquity, constituted part of the lustration of infants. See LUSTRATION.

AMPHIDRYON, in ecclesiastical writers, denotes the veil or curtain which was drawn before the door of the bema in ancient churches.

AMPHIMACER, in ancient poetry, a foot consisting of three syllables, whereof the first and last are long, and that in the middle short: such is the word [cāstĭtās].

AMPHIPNEUMA, with physicians, signifies great difficulty of breathing.

AMPHIPOLES, in antiquity, the principal magistrates of the city of Syracuse in Sicily, called Archons at Athens. See ARCHON.

AMPHIPOLIS, or STRYMON, a town of European Turky, once the capital of Macedonia, situated in E. long. 40° 5′, and N. lat. 41° 30′.

AMPHIPPII, in Grecian antiquity, soldiers who, in war, used two horses without saddles, and were dexterous enough to leap from one to the other.

AMPHIPRORÆ, in the naval affairs of the ancients, vessels with a prow at each end. They were used chiefly in rapid rivers and narrow channels, where it was not easy to tack about.

AMPHIPROSTYLE, in the architecture of the ancients, a temple which had four columns in the front, and as many in the face behind.

AMPHISBÆNA, in zoology, a genus of serpents belonging to the order of amphibia serpentes, so called from the false notion of its having two heads, because it moves with either end foremost.

The head of the amphisbæna is small, smooth, and blunt; the nostrils are very small; the eyes are minute and blackish; and the mouth is furnished with a great number of small teeth. The body is cylindrical, about a foot long, and divided into about 200 annular convex segments like those of a worm; and it has about 40 longitudinal streaks, of which 12 on each side are in the form of small crosses like the Roman X; the anus is a transverse slit; and the last ring or segment of the belly has eight small papillæ, forming a transverse line before the anus; the tail, *i. e.* all the space below the anus, is short, consisting of thirty annular segments, without being marked with the cross-lines, and is thick and blunt at the point. The colour of the whole animal is black, variegated with white; but the black prevails most on the back, and the white on the belly. It has a great resemblance to a worm, living in the earth, and moving equally well with either end foremost. There are but two species, *viz.* 1. the fuliginosa, which answers exactly to the above description, and is found in Lybia, and in different parts of America. 2. The alba, which is totally white, is a native of both the Indies, and is generally found in ant-hillocks. The bite of the amphisbæna is reckoned to be mortal by many authors; but as it is not furnished with dog-fangs, the usual instruments of conveying the poison of serpents, later writers esteem it not to be poisonous. They feed upon ants and earth-worms, but particularly the latter. See plate XI. fig. 2.

AMPHISCII, among geographers, a name applied to the people who inhabit the torrid zone. The Amphiscii, as the word imports, have their shadows one part of the year towards the north, and at the other towards the south, according to the sun's place in the ecliptic. They are also called Ascii. See ASCII.

AMPHISMILA, a diffecting-knife, with a double edge.

AMPHITANE, among ancient naturalifts, a ftone faid to attract gold, as the loadftone does iron.

AMPHITAPA, in antiquity, a garment frized or fhagged on both fides, which was laid under perfons going to fleep.

AMPHITHEATRE, in antiquity, a fpacious edifice, built either round or oval, with a number of rifing feats, upon which the people ufed to behold the combats of gladiators, of wild beafts, and other fports.

Amphitheatres were at firft only of wood; and it was not till the reign of Auguftus, that Statilius Taurus built one, for the firft time, of ftone. The loweft part was of an oval figure, and called arena, becaufe, for the conveniency of the combatants, it was ufually ftrewed with fand; and round the arena were vaults ftiled *caveæ*, in which were confined the wild beafts appointed for the fhews.

Above the caveæ was erected a large circular periftyle, or podium, adorned with columns. This was the place of the emperors, fenators, and other perfons of diftinction.

The rows of benches were above the podium. Their figure was circular; and they were entered by avenues, at the end of which were gates, called vomitoriæ.

The moft perfect remains we now have of amphitheatres, are that of Vefpafian, called the colifeum, that at Verona in Italy, and that at Nifmes in Languedoc.

Amphitheatre, in gardening, a temple erected on a rifing ground, of a femicircular figure. Thefe amphitheatres are formed of ever-greens, obferving always to plant the fhorteft growing trees in the front, and the talleft behind. They are alfo made of flopes on the fides of hills, and covered with turf, being formerly efteemed great ornaments in gardens; but they are now generally excluded, as the natural flope of fuch hills is, to perfons of true tafte, far more beautiful than the ftiff angular flopes of thefe amphitheatres.

AMPHITHURA, in the ancient churches, was the veil or curtain feparating the chancel from the reft of the church.

AMPHODONTA, a term for animals who have teeth in both jaws.

AMPHORA, in antiquity, a liquid meafure among the Greeks and Romans. The Roman amphora contained forty-eight fextaries, and was equal to about feven gallons one pint Englifh wine-meafure; and the Grecian or Attic amphora contained one third more. Amphora was alfo a dry meafure, likewife in ufe among the Romans, and contained three bufhels.

Amphora, among the Venetians, the largeft meafure ufed for liquids. It contains four bigorzas, the bigorza being four quarts, the quart four fachies, and each fachie four leras; but, by wholefale, the amphora is fourteen quarts, and the bigorza three quarts and a half.

Amphora, in aftronomy, a name fometimes ufed for one of the twelve figns of the zodiac, more ufually called aquarius. See Aquarius.

AMPHOTIDES, in antiquity, a kind of armour or covering for the ears, worn by the ancient pugiles, to prevent their adverfaries from laying hold of that part.

AMPHTHILL, a pretty town in the heart of Bedfordfhire in England.

AMPLIATION, in a general fenfe, denotes the act of enlarging or extending the compafs of a thing.

Ampliation, in Roman antiquity, was the deferring to pafs fentence in certain caufes. This the judge did, by pronouncing the word *amplius*; or by writing the letters N. L. for *non liquet*; thereby fignifying, that as the caufe was not clear, it would be neceffary to bring further evidence.

AMPLIFICATION, in rhetoric. See Exaggeration.

AMPLITUDE, in aftronomy, an arch of the horizon intercepted between the eaft or weft point, and the centre of the fun, or a planet at its rifing and fetting, and fo is either north and fouth, or ortive and occafive. See Astronomy.

Magnetical Amplitude, the different rifing or fetting of the fun from the eaft or weft points of the compafs. It is found by obferving the fun, at his rifing and fetting, by an amplitude-compafs.

Amplitude *of the range of a projectile*, the horizontal line, fubtending the path in which the projectile moved.

AMPULLA, in antiquity, a round big-bellied veffel which the ancients ufed in their baths, to contain oil for anointing their bodies. It was alfo a cup made of glafs, and fometimes of leather, for drinking out of at table.

AMPULLACEÆ *conchæ*, in natural hiftory. See Dolia.

AMPURIAS, a town of Spain, capital of the diftrict of Ampouzdan in Catalonia, and fituated in E. long. 2° 50′, and N. lat. 42° 15′.

AMPUTATION, in furgery, the cutting off a limb, or any part, from the body of an animal. See Surgery, title, *Of amputation*.

AMRAS, a ftrong caftle in the Tyroleze, E. long. 12° 10′, N. lat. 47°.

AMSDORFIANS, in church-hiftory, a fect of Proteftants in the XVIth century, who took their name from Amfdorf their leader. They maintained, that good works were not only unprofitable, but were obftacles to falvation.

AMSEGETES, in Roman antiquity, thofe whofe land bordered upon a public road.

AMSTERDAM, a large and beautiful city of Holland, fituated on the river Amftel, and an arm of the fea, called Wye, a little eaftward of the Zuyder-fea, in 4° 30′ E. long. and 52° 20′ N. lat.

It is computed to be half as big as London; and, in point of trade, equal to any town in the known world; there being people in it of almoft every nation and religion of Europe, who apply themfelves with the utmoft diligence to heap up wealth, not with a view to enjoy it, but to have the pleafure of dying rich.

Amsterdam, is alfo the name of a town of the Curacoes, in America: likewife the name of three iflands, one of which lies in the Indian ocean, between New Holland and Madagafcar; the fecond between Peru and

and the iſlands of Solomon; and the third in the Chineſe ſea, between Japan, and the iſland Formoſa.

AMULET, a charm againſt witchcraft, or diſeaſes, *&c.* Theſe amulets were made of ſtone, metal, ſimples, animals, and, in ſhort, of every thing that imagination could ſuggeſt. Amulets ſometimes conſiſted in ſtrange unmeaning words, characters and ſentences.—The ancients were extremely fond of amulets. Notwithſtanding the progreſs of learning and refinement, there is not any country in Europe, even at this day, who do not believe in ſome charm or other.

AMULET, in cookery. See OMELET.

AMULETICS, among phyſicians, a name given to all medicines which are ſuppoſed to act as charms.

AMURCA, the name of an antiquated medicine, prepared by boiling the recrement or dregs of oil of olives to the conſiſtence of honey, and uſed as an aſtringent.

AMURCA, in anatomy. See *Capſula atrabilaria.*

AMUY, a city of India, beyond the Ganges, near the lake Chiamai, on the borders of the kingdom of Kanduana.

AMY, in law, the next friend or relation to be entruſted for an infant. See PROCHEN.

Alien AMY, ſignifies a foreigner here, ſubject to ſome foreign prince, or power, in friendſhip with us.

AMYGDALA, the fruit of the almond-tree.

AMYGDALA is likewiſe uſed for a ſpecies of echinus marinus, a ſhell fiſh. See ECHINUS.

AMYGDALÆ, in anatomy. See Tonſillæ.

AMYGDALOIDES *lapis*, in Nat. hiſt. a foſſile ſubſtance, reſembling the kernel of an almond.

AMYGDALUS, or ALMOND-TREE, in botany, a genus of the icoſandria monogynia claſs. The calix is divided into five ſegments; and the corolla conſiſts of five petals. The ſpecies are three, *viz.* the perſica, or peach-tree; the communis, a native of Mauritania; and the nana, a native of Aſia. Almonds are uſed in medicine as emollient, *&c.*

AMYLON, or AMYLUM, a term given to ſtarch. See STARCH.

AMYRBERIS, in botany. See BERBERIS.

AMYRIS, in botany, a genus of the decandria monogynia claſs. The flower conſiſts of four oblong petals. The ſtygmia is quadrangular; the fruit is a berry of the drupa kind. There are four ſpecies of this genus, *viz.* The elemifera, maritima, toxifera, and balſamifera, all natives of America.

AMYTHAONIS *emplaſtrum*, a plaſter compoſed of gum ammoniac, wax, bdellium, *&c.* ſuppoſed by the ancients to be uſeful in convulſions.

AMZEL, in ornithology, the Engliſh name of a ſpecies of turdus. See TURDUS.

AN JOUR *and* WASTE, in law, ſignifies a forfeiture of lands for a year and a day to the king, by perſons committing petit treaſon and felony, and afterwards the land falls to the lord.

ANA, among phyſicians, denotes a quantity equal to that of the preceding ingredient. It is abbreviated thus, āā, or ā.

ANA, among occult philoſophers, a term uſed to denote the human mind, from whence ſome will have *anaſapta*, a dæmon invoked by ſick perſons, to be derived.

ANABAO, one of the Molucca iſlands, S. W. from Timor.

ANABAPTISTON, the ſame with abaptiſton. See ABAPTISTON.

ANABAPTISTS, a ſect or denomination of Chriſtians, who deduce their original from the apoſtolic age. This name was given them by their opponents, ſoon after the Reformation, by way of ſcorn, and imports *rebaptizing*; but this charge they diſclaim, by denying that the ſprinkling, or pouring of water, upon infants has any relation at all to the ſcripture-ordinance of baptiſm, either as to its *ſubjects* or *mode*.

Though they believe the ſalvation of elect infants; yet they deny their being the proper ſubjects of baptiſm: Becauſe they can find neither precept nor example for ſuch a practice in the N. Teſtament: Becauſe Chriſt's commiſſion to baptize appears to them to reſtrict this ordinance to ſuch only as are taught, or made diſciples, and believe the goſpel, Mat. xxviii. 19. Mark xvi. 16.: Becauſe the apoſtles, in executing Chriſt's commiſſion, never baptized any but thoſe who were firſt inſtructed in the Chriſtian faith, and profeſſed their belief of it, Acts ii. 41. viii. 12. xviii. 8.: And becauſe the nature and deſign of the ordinance is ſuch as can be of no advantage to infants, it being a ſign and repreſentation of ſpiritual bleſſings, intended to impreſs the mind of the perſon baptized with a comfortable ſenſe of what is ſignified thereby, 1 Pet. iii. 21.; and as infants can neither diſcern the ſign nor the thing ſignified, ſo they think they can reap no benefit from it, any more than from the Lord's ſupper, or any other ordinance of the goſpel.

They repell the argument drawn from circumciſion, by diſtinguiſhing betwixt the Old and New Teſtament diſpenſations, and betwixt the natural and ſpiritual ſeed of Abraham, Rom. ix. 8. Gal. iv. 22, 23, 28, 31. and maintain, that as circumciſion belonged to the carnal birth, ſo baptiſm belongs only to the ſpiritual birth, or *theſe who are of faith*, Gal. iii 7. Our Lord's words in Mark x. 13, 14. they conſider as having no relation to infant-baptiſm, as he there neither injoins nor exemplifies it; and they diſtinguiſh betwixt thoſe who may be ſubjects of the kingdom of heaven in God's ſight, and theſe whom he points out to us as proper viſible ſubjects of goſpel-ordinances. The argument from the apoſtles their baptizing whole houſes, they anſwer, by ſhewing that theſe houſes heard the word, believed, were comforted, and abounded in good works, Acts xvi. 32, 34, 40. and xviii. 8. 1 Cor. xvi. 15, 16. and ſo could not be infants.

The mode or manner of baptiſm they affirm to be *dipping* or *immerſing* the whole body in water. This they ſay is the primary and proper meaning of the original word *Babtizô, to dip, immerſe*, or *plunge*. In ſupport of this ſenſe of the word, they produce other places in the N. Teſtament where it is ſo rendered, as Mat. xxvi. 23. Luke xvi. 24. John xiii. 26. Rev. xix. 13. as alſo the circumſtances of our Lord's baptiſm

tiſm in Jordan, Mat. iii. 16. Mark i. 9, 10. and of the eunuch's, Acts viii. 38, 39. and the reaſon of John's baptizing in Enon, John iii. 23. Hence they affirm, that no other mode can be called baptiſm, or ſo fitly repreſent communion with Chriſt in his death, burial, and reſurrection, which is expreſsly the deſign of baptiſm, Rom. vi. 3, 4, 5.

Great troubles were occaſioned in Germany by ſome who profeſſed this tenet; but of all places where they prevailed, none ſuffered ſo much by them as the town of Munſter. The Anabaptiſts, however, of Holland and Frizland diſapproved of their ſeditious behaviour: and at preſent, though this ſect ſtill ſubſiſts, as well in Britain as abroad, yet they no longer pretend to be divinely inſpired; they no longer oppoſe magiſtrates, nor preach up a community of goods. Thoſe of them in England differ very little from the Proteſtant diſſenters, except in rejecting infant-baptiſm; as appears from their confeſſion of faith publiſhed 1689.

Within theſe four years, the Anabaptiſts have formed a congregation in Edinburgh, (which is the firſt appearance they ever made in Scotland), and ſeem to be a ſerious inoffenſive people. They pray for the king and all inferior magiſtrates, and ſubject themſelves (in civil matters) to every ordinance of man, for the Lord's ſake. They conſider the kingdom of Chriſt to be ſpiritual, and not of this world; and are ſtrictly upon the congregational or independent plan, admitting of no juriſdiction or authority (in matters of religion) but that of the Great Lawgiver. Their church-officers are biſhops (or elders) and deacons, and theſe they generally chuſe from among themſelves. They make the reading of the ſcriptures a part of their public ſervice, and eat the Lord's ſupper every ſabbath-day. Their diſciples, before they are admitted into communion, are firſt baptized in the Water of Leith, which they do at all ſeaſons of the year; and, on theſe occaſions, they are generally attended by a great number of ſpectators *.

ANABLEPS, in ichthyology, the trivial name of a ſpecies of cobitis. See Cobitis.

ANABOLÆUM, or Anabole, in antiquity, a kind of great or upper coat, worn over the tunica. See Tunica.

ANABOLEUS, in antiquity, an appellation given to grooms of the ſtable, or equerries, who aſſiſted their maſters in mounting their horſes. As the ancients had no ſtirrups, or inſtruments that are now in uſe for mounting a horſe, they either jumped upon his back, or were aided in mounting by anabolei.

ANABROCHISMUS, an obſolete term among phyſicians, for removing offenſive hairs from the eye-lids.

* *As we chuſe to avoid every kind of miſrepreſentation, eſpecially in matters of religious opinion; and as the moſt genuine and ſatisfactory account of the origin and principles of any ſect is to be expected from themſelves; we applied to the preachers of the Anabaptiſt congregation at Edinburgh, from whom we had the above account.—The ſame conduct will be obſerved with regard to every other ſect of any note.*

ANABROSIS, ſignifies a corroſion by acrid humours.

ANACA, in ornithology, an obſolete name of a ſpecies of pſittacus. Psittacus.

ANACALYPTERIA, in antiquity, feſtivals among the Greeks on the day that the bride was permitted to lay aſide her veil, and appear in public. The word is derived from a verb which ſignifies to *uncover*.

ANACAMPSEROS, in botany, a ſynonyme of the portulaca, and ſeveral other plants.

ANACAMPTERIA, in eccleſiaſtical antiquity, a kind of little edifices adjacent to the churches, deſigned for the entertainment of ſtrangers and poor perſons.

ANACAMPTIC, a name applied by the ancients to that part of optics which treats of reflection, being the ſame with what is now called catoptrics. See Catoptrics.

ANACARDIUM, or Cashew-nut-tree, in botany, a genus of the decandria monogynia claſs, of which there is but one ſpecies, *viz.* the occidentale, a native of the Indies. The calix is divided into five parts; the flower conſiſts of one quinqueſide petal; the fruit is a kidney-ſhaped nut, incloſed in a fleſhy receptacle. The kernel is of the ſame nature with an almond: The acrid juice contained between the kernels is recommended for tetters and other cutaneous diſeaſes.

ANACATHARSIS, ſignifies a ſalivation, or diſcharge of noxious humours by ſpitting.

ANACATHARTICS, properly ſignify ſuch medicines as promote the diſcharge of ſaliva.

ANACEPHALÆOSIS, in rhetoric, the ſame with recapitulation. See Recapitulation.

ANACHIMOUSSI, a country in the iſland of Madagaſcar, bordering on the ſouth with Manaboule.

ANACHORET, in church-hiſtory, denotes a hermit, or ſolitary monk, who retires from the ſociety of mankind into ſome deſart, with a view to avoid the temptations of the world, and to be more at leiſure for meditation and prayer.

Such were Paul, Anthony, and Hilarion, the firſt founders of monaſtic life, in Egypt and Paleſtine.

Anachorets, among the Greeks, conſiſt principally of monks, who retire to caves or cells, with the leave of the abbot, and an allowance from the monaſtery; or who, weary of the fatigues of the monaſtery, purchaſe a ſpot of ground, to which they retreat, never appearing again in the monaſtery, unleſs on ſolemn occaſions.

ANACHRONISM, in matters of literature, an error with reſpect to chronology, whereby an event is placed earlier than it really happened, in which ſenſe it ſtands oppoſed to *Parachroniſm*.

ANACLASTICS, that part of optics which conſiders the refraction of light. See Refraction, and Optics.

ANACLASTIC *glaſſes*. See Glass.

ANACLETERIA, in antiquity, a ſolemn feſtival celebrated by the ancients when their kings or princes came of age, and aſſumed the reins of government. It is ſo called, becauſe proclamation being made of this event to the people, they went to ſalute their prince during the anacleteria, and to congratulate him upon his new dignity.

ANA-

ANACLINOPALE, among the ancient athletæ, a kind of wreſtling, performed on the ground.

ANACLINTERIA, in antiquity, thoſe parts of the triclinear couches on which a cuſhion was placed for ſupporting the head.

ANACOLLEMA, a compoſition of aſtringent powders, applied by the ancients to the head, to prevent defluctions on the eyes.

ANACREONTIC *verſe*, in ancient poetry, a kind of verſe, ſo called from its being much uſed by the poet Anacreon. It conſiſts of three feet and an half, uſually ſpondees and iambuſes, and ſometimes anapeſts: Such is that of Horace,

Lydia, dic per omnes.

ANACRISIS, among civilians, an inveſtigation of truth, interrogation of witneſſes, and inquiry made into any fact, eſpecially by torture.

ANACUICS, in geography, a people of Brazil in America.

ANACYCLUS, in botany, a genus of the ſyngeneſia polygamia ſuperflua claſs. The receptacle of the anacyclus is paleaceous; the pappus emarginated; and the ſeeds have membranaceous edges. There are three ſpecies of this genus, *viz.* the creticus, orientalis, and valentinus, all natives of the eaſt.

ANADAVADÆA, in ornithology, a barbarous name of a ſpecies of alauda. See ALAUDA.

ANADEMA, in antiquity, denotes the fillet which the kings of Perſia wore round their head. It denotes alſo a kind of ornament which women wore on their heads like a garland.

ANADIPLOSIS, in rhetoric and poetry, a repetition of the laſt word of a line, or clauſe of a ſentence, in the beginning of the next: Thus,

Pierides, vos hæc facietis maxima Gallo:
Gallo, cujus amor, &c.
Et matutinis accredula vocibus inſtat,
Vocibus inſtat, & aſſiduas jacit ore querelas.

ANADOLI, the name by which the Turks call Natolia. See NATOLIA.

ANADOLI *hiſſari*, a name given by the Turks to the caſtle of the Dardanelles, on the Aſiatic ſide.

ANADOSIS, among phyſicians, the diſtribution of the aliment over the body.

ANADROMOUS, among ichthyologiſts, a name given to ſuch fiſhes as go to the ſea from the freſh waters at ſtated ſeaſons, and return back again, ſuch as the ſalmon, *&c.* See SALMON.

ANÆDEIA, in Grecian antiquity, a ſtool whereon the accuſed perſon was placed to make his defence.

ANÆSTHESIA, ſignifies a privation of the ſenſes.

ANAGALLIS, in botany, a genus of the pentandria monogynia claſs. The corolla of this plant conſiſts of one rotated petal. There are four ſpecies of anagallis, *viz.* the arvenſis, or male pimpernel, a native of Britain; the monelli, a native of Verona; the latifolia and the linifolia, both natives of Spain. The anagallis is ſuppoſed to be deterſive and healing.

ANAGARSKAYE, a city of Muſcovitiſh Tartary, in the province of Dauria, near the ſource of the river Amour. See AMOUR.

ANAGLYPHICE, or ANAGLYPTICE, denotes the art of emboſſing. See EMBOSSING.

ANAGNI, a town of Italy in the Campagna di Roma, ſituated about 32 miles E. of Rome, in 13° 45′ E. long. and 42° N. lat.

ANAGNOSTA, or ANAGNOSTES, in antiquity, a kind of literary ſervant, retained in the families of perſons of diſtinction, whoſe chief buſineſs was to read to them during meals, or at any other time when they were at leiſure.

ANAGOGICAL, ſignifies myſterious, tranſporting, and is uſed to expreſs whatever elevates the mind.

ANAGOGY, or ANAGOGE, among eccleſiaſtical writers, the elevation of the mind to things celeſtial and eternal.

ANAGRAM, in matters of literature, a tranſpoſition of the letters of ſome name, whereby a new word is formed, either to the advantage or diſadvantage of the perſon or thing to which the name belongs. Thus from Galenus, is formed Angelus; from James, Simea; and ſo of others.

ANAGRAMMATIST, a perſon who compoſes or deals much in anagrams.

ANAGROS, in commerce, a meaſure for grain uſed in ſome cities of Spain, particularly at Seville; 46 anagros make about 10$\frac{1}{4}$ quarters of London.

ANAGYRIS, in botany, a genus of the decandria monogynia claſs. This plant has a papilionaceous vexillum, the alæ of which are ſhorter than the carina. The capſule is a legumen. There is only one ſpecies of anagyris, *viz.* the fætida, a native of Spain, Sicily, and Italy. The leaves are ſaid to be laxative, and the ſeeds emetic.

ANALABE, in the Greek church, a part of the dreſs of the eaſtern monks, anſwerable to the ſcapular of the weſt. See SCAPULAR.

ANALECTA, or ANALECTES, in antiquity, a ſervant whoſe employment it was to gather up the off-falls of tables.

ANALECTA, *analects*, in a literary ſenſe, is uſed to denote a collection of ſmall pieces, as eſſays, remarks, *&c.*

ANALEMMA, in geometry, a projection of the ſphere on the plane of the meridian, orthographically made by ſtraight lines and ellipſes, the eye being ſuppoſed at an infinite diſtance, and in the eaſt or weſt points of the horizon.

ANALEMMA, denotes likewiſe an inſtrument of braſs or wood, upon which this kind of projection is drawn, with an horizon and curſor fitted to it, wherein the ſolſtitial colure, and all circles parallel to it, will be concentric circles; all circles oblique to the eye, will be ellipſes; and all circles whoſe planes paſs through the eye, will be right lines.

The uſe of this inſtrument is to ſhew the common aſtronomical problems, which it will do, though not very exactly, unleſs it be very large.

ANALEPSIS, the augmentation or nutrition of an emaciated body.

ANALEPTICS, reſtorative or nouriſhing medicines.

ANALOGICAL, in a general ſenſe, denotes ſomething belonging to, or partaking of the nature of analogy.— Hence,

ANALOGICAL *ſyllogyſm*, is one whoſe force chiefly depends on the analogy between the two premiſſes.

ANALOGISM, among logicians, the arguing from the cauſe to the effect.

ANALGISTA, among civilians, denotes a tutor who is not obliged to give an account of his conduct.

ANALOGY, in matters of literature, a certain relation and agreement between two or more things, which in other reſpects are entirely different.

There is likewiſe an analogy between beings that have ſome conformity or reſemblance to one another; for example, between animals and plants; but the analogy is ſtill ſtronger between two different ſpecies of certain animals.

Analogy enters much into all our reaſoning, and ſerves to explain and illuſtrate. A great part of our philoſophy has no other foundation than analogy, the utility of which conſiſts in ſuperſeding all neceſſity of examining minutely every particular body; for it ſuffices us to know that every thing is governed by general and immutable laws, in order to regulate our conduct with regard to all ſimilar bodies, as we may reaſonably believe that they are all endowed with the ſame properties: Thus, we never doubt that the fruit of the ſame tree has the ſame taſte.

ANALOGY, among geometricians, denotes a ſimilitude of ratios. See RATIO.

ANALOGY, in medicine, the reſemblance obſervable between different diſeaſes, which indicates a ſimilar treatment.

ANALOGY, among grammarians, is the correſpondence which a word or phraſe bears to the genius and received forms of any language.

ANALOGY *of doctrine*, among critics, is the explaining the paſſage of an author, in a manner conſiſtent with the ſyſtem which he is known to have generally followed.

ANALOGY, in rhetoric, a figure of ſpeech, otherwiſe called compariſon. See COMPARISON.

ANALYSIS, in a general ſenſe, is the reſolution of ſomething compounded, into its conſtituent parts. Hence,

ANALYSIS, among logicians, is the reſolving of knowledge into original principles, by tracing things backward to their cauſes.

ANALYSIS, among mathematicians, the art of diſcovering the truth or falſehood of a propoſition, or its poſſibility or impoſſibility. This is done by ſuppoſing the propoſition, ſuch as it is, true; and examining what follows from thence, until we arrive at ſome evident truth, or ſome impoſſibility, of which the firſt propoſition is a neceſſary conſequence; and from thence eſtabliſh the truth or impoſſibility of that propoſition.

ANALYSIS, in chemiſtry, the reducing of an heterogeneous or mixt body, into its original principles or component parts. See CHEMISTRY.

ANALYSIS, is alſo uſed to ſignify the anatomical diſſection of an animal. See ANATOMY.

ANALYSIS, among grammarians, is the explaining the etymology, conſtruction, and other properties of words.

ANLYSIS *of powers*, is the operation of reſolving them into their roots, otherwiſe called evolution. See ALGEBRA, and ARITHMETIC.

ANALYSIS, is alſo uſed for a brief, but methodical illuſtration of the principles of a ſcience; in which ſenſe it is nearly ſynonymous with what we otherwiſe call a ſynopſis.

ANALYSIS, likewiſe denotes a table of the principal heads of a continued diſcourſe, diſpoſed in their natural order.

ANALYST, a perſon who makes uſe of the analytical method of reſolving problems.

ANALYTIC, or ANALYTICAL, in a general ſenſe, denotes ſomething belonging to the analyſis. See ANALYSIS. It is more particularly uſed for the mathematical and logical analyſis, above explained.

ANAMNESTICS, among phyſicians, ſigns or ſymptoms from which the preſent ſtate of the body is diſcovered.

ANAMORPHOSIS, in perſpective, and painting, a monſtrous projection, or repreſentation of an image, on a plane or curve ſurface, which, beheld at a proper diſtance, ſhall appear regular, and in proportion. See PERSPECTIVE.

ANANAS, in botany, the trivial name of a ſpecies of bromelia. See BROMELIA.

ANANCITIS, in antiquity, a kind of figured ſtone, otherwiſe called *ſynochitis*, celebrated for its magical virtue of raiſing the ſhadows of the infernal gods.

ANANTHOCYCLUS, in botany. See COLUTEA.

ANAPEST, in ancient poetry, a foot conſiſting of two ſhort ſyllables, and one long: Such is the word ſcŏpŭlōs. It is juſt the reverſe of the dactyl. See DACTYL.

ANAPÆSTIC *verſes*, thoſe conſiſting wholly or chiefly of anapæſts.

ANAPES, a town in Flanders, ſituated upon the river Marque, ſomething more than a league's diſtance from Liſle.

ANAPHORA, in rhetoric, the repetition of the ſame word or words in the beginning of a ſentence, or verſe: Thus Virgil,

> *Pan etiam Arcadiâ mecum ſe judice certet,*
> *Pan etiam Arcadiâ dicat ſe judice victum.*

ANAPHORA, among phyſicians, the throwing off purulent matter by the mouth.

ANAPHRODISIA, ſignifies impotence, or want of power to procreate.

ANAPLASIS, ſignifies the replacing or ſetting a fractured bone.

ANAPLEROSIS, among phyſicians. See PLETHORA.

ANAPLEROTICS, medicines that promote the growth or granulation of the fleſh, in wounds, ulcers, &c.

ANAPODOPHYLLUM, in botany. See PODOPHYLLUM.

ANAPULA, a province of Venezuela in South America.

Fig. 1. AMARYLLIS or Crimson oriental Lilly Plate. XII.

Fig. 2. AMPHISBÆNA

Fig. 3. ANAS ARBOREA or Whistling Duck

A. Bell Sculp.

ANAQUITO, a country of Peru, in South America, in the government of Quito.

ANARCHY, in matters of polity, ſuch a confuſion in the ſtate, that no ſupreme authority is lodged either in the prince or other rulers, and conſequently the people live at large, without ſubordination, or any reſpect for the laws.

ANARICHAS, in ichthyology, a genus of fiſhes of the order of apodes. The head of the anarichas is a little obtuſe; the teeth are thick ſet and roundiſh. The ſix fore ones, both above and below, are conical and diverging; the inferior and palate molares are round; the branchioſtege membrane has ſix rays; the body is ſomewhat cylindrical; the tail-fin is diſtinct. There is one ſpecies of this genus; *viz.* the anarichas lupus, or ſea-wolf. It grows generally to four or five feet in length. The lapis bufonites or lycodentes is the teeth of the anarichas petrified. It is a native of the northern coaſt of England.

ANARRHINON, in botany. See ANTIRRHINUM.

ANARRHOPIA, among phyſicians, a tendency of the humours to the head or ſuperior parts.

ANAS, in ornithology, a genus of birds belonging to the order of anſeres. The beak of this genus is a little obtuſe, covered with an epidermis or ſkin, gibbous at the baſe, and broad at the apex; the tongue is obtuſe and fleſhy; the feet are webbed and fitted for ſwimming. Under this genus Linnæus comprehends 38 ſpecies, *viz.* 1. The cygnus, or ſwan, with a ſemicylindrical black bill, yellow wax, and a white body. It is the wild ſwan of Engliſh authors, and a native of Europe and N. America. Linnæus ſays, they frequently viſit Sweden after a thaw; and they are caught with apples in which a hook is concealed. 2. The cygnoides, with a ſemicylindrical bill, gibbous wax, and tumid eye-brows: It is the ſwan-gooſe of Ray, from Guinea. There is likewiſe a variety of this ſpecies, of a leſs ſize, called the gooſe of Muſcovy. 3. The tadorna, with a flat bill, a compreſſed forehead, a greeniſh black head, and the body is variegated with white. It is the ſhell-drake of Ray, and frequents the ſea-coaſts of Europe. 4. The ſpectabilis, has a compreſſed bill, gibbous at the baſe, a black feathery carina, and a hoary head. It is the grey-headed duck of Edwards, and is a native of Sweden and Canada. 5. The fuſca, is of a blackiſh colour, has a white ſpot behind the eyes, and a white line on the wings. The male of this ſpecies is diſtinguiſhed by a gibboſity at the baſe of the bill. It is the black duck of Ray, and a native of the European ſeas. 6. The nigra, is totally black, and has a gibboſity at the baſe of the bill; the tail reſembles a wedge; the female is browniſh. It is the leſſer black duck of Ray, and a native of Britain and Lapland. 7. The anſer, has a ſemicylindrical bill; the upper part of the body is aſh-coloured, but paler below; and the neck is ſtreaked. It is the wild-gooſe of Ray, and is a native of Europe and America. There is a variety of this ſpecies from America, which Edwards calls the laughing-gooſe; it has a white ring at the baſe of the bill, and its neck is ſtreaked. The anſeres migrate in large troops. 8. The erythropus, is of a grey colour, and has a white forehead. It inhabits the north of Europe. 9. The canadenſis, is brown, the neck and head are black, and the throat white. It is a native of Canada. 10. The cœruleſcens, is greyiſh above, and white underneath; the covert feathers of the wings and back are bluiſh. It is the blue-winged gooſe of Edwards, and a native of Canada. 11. The bernicla, is of a brown colour; with the head, neck, and breaſt black; and a white collar. It is the brent-gooſe of Ray, and is a native of the northern parts of Europe. 12. The molliſſima, or cutbert-duck of Ray, has a cylindrical bill, and the wax is divided behind and wrinkled. The feathers, which are very ſoft and valuable, fall off during incubation. The male is white above, but black below and behind; the female is greeniſh. It is a native of the north of Europe. 13. The moſchata, or Muſcovy duck of Ray, has a naked papillous face, and is a native of India. 14. The bahamenſis, or Bahama duck, is grey, with a lead-coloured bill. It has a tawny ſpot on the ſides, and a green yellowiſh ſpot on the wings. It is a native of Bahama. 15. The albeola, or little black and white duck, has a black back and wings; the head is bluiſh, and white on the hinder-part. It is a native of America. 16. The clypeata, or ſhoveler of Ray, has the end of its bill broad and rounded, and a crooked nail at the end of it. It is found near the European ſhores. 17. The ſtrepera, or flat-billed duck of Aldrovandus, has the wings variegated with black, white, and red. It frequents the freſh waters of Europe. 18. The bucephala, or leſſer duck of Cateſby, has the back and wings black; and the head, both above and below, is interſperſed with ſhining ſilky feathers. It frequents the freſh waters of N. America. 19. The clangula, or golden-eye of Ray, is variegated with black and white, and the head is interſperſed with blackiſh green feathers; it has a white ſpot near the mouth. It dives much in queſt of ſhell-fiſh; the eyes are of a ſhining gold colour. 20. The ruſtica, is browniſh, or aſh-coloured, with a white ſpot on the ears and wings. It is a native of N. America. 21. The perſpicillata, or great black duck, is white on the top of the head and of the neck, and has a black ſpot on the bill, immediately behind the noſtrils. It is a native of Canada. 22. The glaucion, or greater wild-duck of Ray, has the iris of the eyes yellow, a grey head, and white collar. It frequents the northern ſhores of Europe. 23. The penelops, or widgeon of Ray, has a ſharpiſh tail, black below; the head is brown, and the forehead white. It inhabits the marſhy parts of Europe. 24. The acuta, or ſea-pheaſant of Ray, has a long acuminated tail, black below, and a white line on each ſide of the back part of the head. It is a native of Europe. 25. The hyemalis, or long-tailed duck, has a tail ſhaped like a wedge, and long tail-feathers; the body is grey, and the temples white. It is a native of Europe and America. 26. The ferina, or red-headed widgeon of Ray, has aſh-coloured wings, and a black rump. It frequents the maritime parts of Europe.

rope. 27. The querquedula, or firſt teal of Aldrovandus, has a green ſpot on the wings, and a white line above the eyes. It frequents the freſh waters of Europe. 28. The crecca, or common teal, has a green ſpot on the wings, and a white line both above and below the eyes. It frequents the freſh waters of Europe. This ſpecies is to be met with in Duddingſton-loch, a freſh-water lake, within a mile of Edinburgh. 29. The hiſtrionica, or duſky-ſpotted duck of Edwards, is of a brown colour, variegated with white and blue; has a double line on the ears and temples; the collar is white, and there is a white ſtreak on the neck. It is a native of America. 30. The minuta, or little brown and white duck of Edwards, is of a greyiſh colour, with white ears, and the prime feathers of the wings blackiſh. It is a native of Canada. 31. The circia, or ſummer-teal of Ray, with the wings variegated with white ſpots, a white line above the eyes, and the beak and feet of an aſh-colour. It frequents the lakes of Europe. 32. The autumnalis, or red-billed whiſtling duck of Edwards, is of a grey colour, with the prime feathers of the wings, the tail, and belly black; and the area of the wings yellow and white. It is a native of America. 33. The boſchas, or common wild-duck of Ray; the intermediate tail-feathers of the drake are turned backward, and the bill is ſtrait. It frequents the lakes of Europe. This duck feeds upon frogs and ſeveral ſorts of inſects.—The wild duck builds its neſt among ruſhes or heath, near the water, and lays 12 or 14 eggs. At moulting-time, when they cannot fly, great numbers of them are taken with nets. Birds with flat bills, that find their food by groping, have three pair of nerves that extend to the end of their bills: theſe nerves are remarkably conſpicuous in the head and bill of the wild-duck; and are larger than thoſe of a gooſe, or any other bird yet known. This is the reaſon they grope for food more than any other bird whatever.—34. The adunca, or hook-billed domeſtic duck of Ray, has the ſame characters with the boſchas, excepting that the bill is crooked. 35. The galericulata, or Chineſe teal of Edwards, has a hanging creſt; and on the hinder part of the back, on both ſides, there is a crooked, flat, elevated feather; the creſt is green and red; and the back is brown, and ſpotted with blue; the erect feathers on the back are red and blunt; one edge of the inmoſt wing-feather, when the wings are ſhut, is raiſed over the back, and is red, and like a ſickle before. It is a native of China. 36. The ſponſa, or ſummer-duck of Cateſby, has a depending green creſt, variegated with blue and white; the back is likewiſe variegated with blue and white; the breaſt is grey, and ſpotted with white; and the throat is white. It is a native of N. America. 37. The arborea, or black-billed whiſtling-duck of Edwards, is of a reddiſh brown colour, with a ſort of creſt on the head; the belly is ſpotted with black and white. It is a native of America. Sloane informs us, that this duck perches on trees; that it is about 20 inches long, from the end of the bill to the point of the tail; that it makes a kind of whiſtling noiſe, from which circumſtance it has received its name. See plate XII. fig. 3. 38. The fuligula, or tufted-duck of Ray, has a hanging creſt, a black body, and the wings and belly ſpotted with white. It is a native of Europe. The male of this ſpecies diſappears during the incubation of the female.

ANAS *campeſtris*, in ornithology. See TETRAO.

ANASCAPTA, among phyſicians. See ANA.

ANASARCA, in medicine, a ſpecies of dropſy, in which the ſkin is puffed up and ſwelled, and the impreſſion of the fingers remain, for ſome time, in the part to which they are applied, but principally in the legs. See MEDICINE, title, *Dropſy*.

ANASSA, or ANASSIS, in botany, a ſynonime of a ſpecies of bromelia. See BROMELIA.

ANASTALTICS, in pharmacy. See STYPTICS.

ANASTASIS, a term among ancient phyſicians, for a riſing up to go to ſtool. It alſo ſignifies the paſſage of any humour, when expelled from one part, and obliged to remove to another.

ANASTATICA, or roſe of Jericho, in botany, a genus of the tetradynamia ſiliculoſa claſs. The flower conſiſts of four roundiſh petals, diſpoſed in the form of a croſs; the ſeed is a ſhort bilocular pod, containing in each cell a ſingle roundiſh ſeed. There are two ſpecies of the anaſtatica, *viz.* the hierochuntica, a native of the ſandy parts of Paleſtine, and the ſhores of the Red-ſea; and the Syriaca, a native of Syria.

ANASTOCCHICOSIS, ſignifies a reſolution of the ſolids and fluids.

ANASTOMASIS, or ANASTOMOSIS, in anatomy, the opening of the mouths of veſſels, in order to diſcharge their contained fluids. It is likewiſe uſed for the communication of two veſſels at their extremities; as the inoſculation of a vein with a vein, of an artery with an artery, or of an artery with a vein.

ANASTOMATICS, medicines ſuppoſed to have the power of opening the mouths of the veſſels, and promoting the circulation; ſuch as deobſtruent, cathartic, and ſudorific medicines.

ANASTROPHE, in rhetoric, denotes the inverſion of the natural order of words.

ANATHEMA, among eccleſiaſtical writers, imports whatever is ſet apart, ſeparated, or divided; but is moſt uſually meant to expreſs the cutting off a perſon from the privileges of ſociety, and communion with the faithful.

The anathema differs from excommunication in the circumſtances of being attended with curſes and execrations. It was practiſed in the primitive church againſt notorious offenders; and the form of that pronounced by Synecius againſt one Andronicus, is as follows: "Let no church of God be open to Andro-
" nicus, but let every ſanctuary be ſhut againſt him.
" I admoniſh both private men and magiſtrates, nei-
" ther to receive him under their roof, nor to their
" table; and prieſts more eſpecially, that they neither
" converſe with him living, nor attend his funeral
" when dead."

Several councils alſo have pronounced anathemas againſt ſuch as they thought corrupted the purity of the

Plate XIII

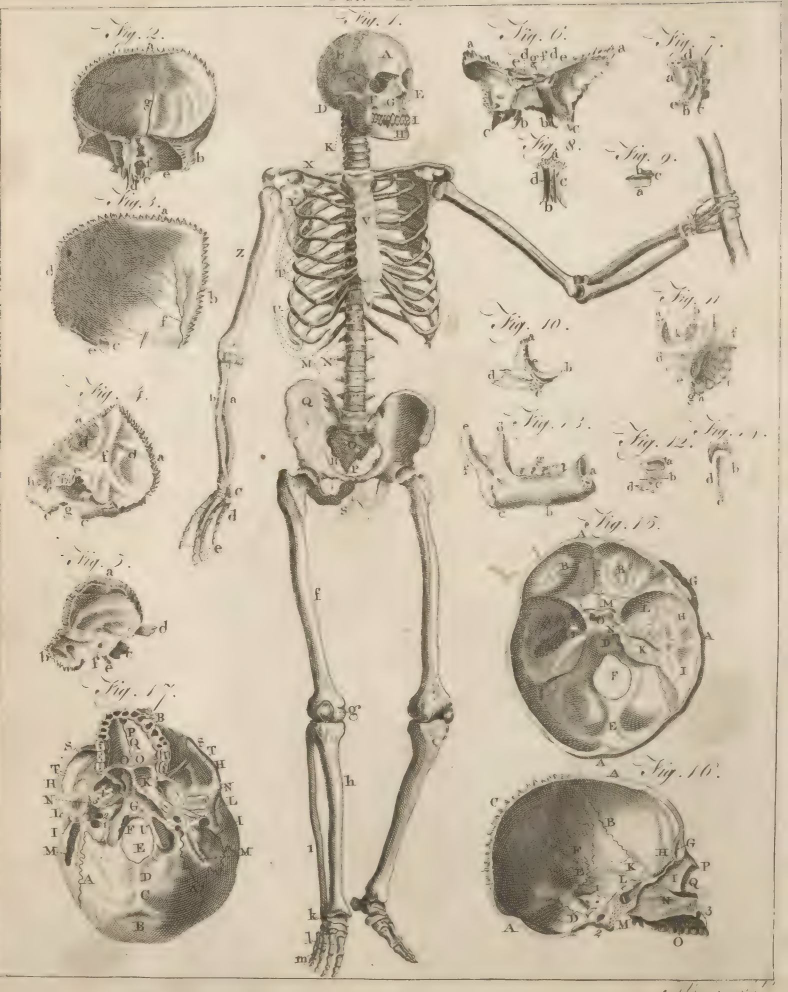


Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6.
Fig. 7.
Fig. 8.
Fig. 9.
Fig. 10.
Fig. 11
Fig. 12.
Fig. 13.
Fig. 14.
Fig. 15.
Fig. 16.
Fig. 17.

Plate XIV.

A. Bell sculpt

the faith; and their decisions have been conceived in the following form: *Si quis dixerit*, &c. *anathema sit*.

There are two kinds of anathemas, the one judiciary, and the other abjuratory. The former can only be denounced by a council, a pope, or a bishop; the latter makes a part of the ceremony of abjuration, the convert being obliged to anathematize the heresy he abjures.

ANATHEMA, in heathen antiquity, was an offering or present made to some deity, and hung up in the temple. Whenever a person left off his employment, it was usual to dedicate the tools to the patron-deity of the trade. Persons too who had escaped from imminent danger, as shipwreck and the like, or had met with any other remarkable instance of good fortune, seldom failed to testify their gratitude by some present of this kind.

ANATHEMA likewise denotes Christian offerings, otherwise called donations. See DONATIONS.

ANATHEMATIZING, the act of pronouncing an anathema against some person. See ANATHEMA.

ANATICULA, *little duck*, in the ancient Roman customs, a term of fondness used by lovers.

ANATIFERA *concha*, the trivial name of a species of the lepas, a testaceous animal. See LEPAS.

ANATOLIA, in geography, the same with Natolia. See NATOLIA.

ANATOMICAL, an epithet applied to any thing belonging to anatomy. See ANATOMY.

ANATOMY.

ANATOMY is the art of dissecting the solid parts of animal bodies, with a view to discover their structure, connection, and uses.

ANATOMY is not only the basis of all medical knowledge, but is a very interesting object to the philosopher and natural historian.

In treating this useful subject, we shall divide it into the following parts: I. Of the BONES. II. Of the MUSCLES. III. Of the ARTERIES. IV. Of the VEINS. V. Of the NERVES. VI. Of such parts of the body as are not comprehended in any of the above, *e. g.* The BRAIN, THORAX, ABDOMEN, *&c. &c.*

PART I.

OF THE BONES.

SECT. I. *Of the* BONES *in general.*

BEFORE we examine the structure of the bones, the periosteum, a membrane with which they are covered, must be described.

The periosteum can be divided into layers of fibres. The exterior ones, composed of the fibres of the muscles connected to the bones, vary in their number, size, and direction, and consequently occasion a very great difference in the thickness and strength of the periosteum of different bones. The internal layer is every where nearly of a similar structure, and has its fibres in the same direction with those of the bone to which they are contiguous.

Except where muscles, cartilages, or ligaments, are inserted into the periosteum, its external surface is connected to the surrounding parts by thin cellular membranes, which can easily be stretched considerably, but shorten themselves whenever the stretching force is removed.

When the periosteum is torn off from bones, we see a great number of white threads produced from that membrane into them; and after a successful injection of the arteries with a red liquor, numerous vessels are not only seen on the periosteum, but most of the fibres sent from the membrane to the bone shew themselves to be vessels entering it, with the injected liquor in them; and when they are broken, by tearing off the periosteum, the surface of the bone is almost covered with red points.

The great sensibility of the periosteum in the deep-seated species of paronychia, in exostoses, nodi, tophi, and gummata, from a lues venerea, or whenever this membrane is in an inflamed state, is a sufficient proof that it is well provided with nerves; though they are perhaps too small to be traced.

The chief uses of the periosteum are: 1. To allow the muscles, when they contract or are stretched, to move and

and slide easily upon the bones. 2. To keep in due order, and to support the vessels in their passage to the bones. 3. By being firmly braced on the bones, to assist in setting limits to their increase, and to check their overgrowth. 4. To strengthen the conjunction of the bones with their epiphyses, ligaments, and cartilages, which are easily separated in young creatures, when this membrane is taken away. 5. To afford convenient origin and insertion to several muscles which are fixed to this membrane. And, lastly, to warn us when any injury is offered to the parts it covers.

The Bones are the most hard and solid parts of the body, and generally of a white colour; only in a living creature they are bluish, which is owing to the blood in the small vessels under their surface.

Bones are composed of a great many plates, each of which is made up of fibres or strings united by smaller fibrils; which being irregularly disposed and interwoven with the other larger fibres, make a reticular work.—— This texture is plainly seen in the bones of fœtuses, which have not their parts closely compacted, and in the bones of adults, which have been burnt, long exposed to the weather, or whose composition has been made loose by diseases.

The plates are said to be firmly joined to each other by a great number of claviculi, or small bony processes, which, rising from the inner plates, pierce through some, and are fixed into the more external ones.

Though the exterior part of bones is composed of firm compact plates, yet they are all more or less cavernous internally. In some, the solid sides are brought so near, that little cavity can be seen; and in others, the cavities are so large, that such bones are generally esteemed to be hollow or fistular. But the internal spongy texture is most evident in young animals.

This spongy, cavernous, internal part of bones, is generally called their *cancelli* or *lattice-work*.

The twisting and windings which these cancelli make, and the interstices which they leave, differ considerably in figure, number, and size; and therefore form little cells, which are as different, but communicate with each other.

The cancelli sustain the membranous bags of the marrow which are stretched upon them, and thereby hinder these membranous parts from being torn or removed out of their proper places, in the violent motions and different postures which the bones are employed in.

The depressions between the fibres of the external plates of bones appear like so many furrows on their surface, into each of which the periosteum enters.

Both on the ridges and furrows, numerous little pits or orifices of canals are to be seen, by which the vessels pass to and from the bones.

After a successful injection, the arteries can be traced in their course from the pits to the plates and fibres.

We may conclude, from arteries being accompanied with veins, so far as we can trace them in every other part of the body, that there are also veins in the bones.

The bones of a living animal are so insensible that they can be cut, rasped, or burnt, without putting the creature to pain, and the nerves distributed in their substance cannot be shewn by dissection; from which it might be inferred, that they have no nerves distributed to them: But the general tenor of nature, which bestows nerves to all the other parts, should prevent our drawing such a conclusion.

The vascular texture of bones must make them subject to obstructions, ecchymoses, ulcers, gangrenes, and most other diseases which the softer parts are affected with; and therefore there may be a greater variety of *caries* than is commonly described.

On the internal surface of the solid parts of bones, there are orifices of canals, which pass outwards through the plates to open into other canals that are in a longitudinal direction, from which other transverse passages go out to terminate in other longitudinal canals; and this structure is continued through the whole substance of bones, both these kinds of canals becoming smaller gradually as they approach the outer surface.—These canals are to be seen to the best advantage in a bone burnt till it is white: When it is broken transversely, the orifices of the longitudinal canals are in view; and when we separate the plates, the transverse ones are to be observed.

Most bones have one or more large oblique canals formed through their sides for the passage of the medullary vessels.

The bones sustain and defend the other parts of the body

Bones are lined within, as well as covered externally, with a membrane; which is therefore commonly called *periosteum internum*.

The internal periosteum is an extremely fine membrane; nay, frequently it has a loose reticular texture; and therefore it is compared by some to the arachnoide coat of the spinal marrow: so that we cannot expect to divide it into layers as we can divide the external periosteum. We can, however, observe its processes entering into the transverse pores of the bones, where probably they are continued to form the immediate canals for the marrow distributed through the substance of the bones; and along with them vessels are sent, as from the external periosteum, into the bone. These processes being of a very delicate texture, the adhesion of this membrane to the bone is so small, that it separates commonly more easily from the bone than from the marrow which it contains.

From the internal surface of the internal periosteum, a great number of thin membranes are produced; which, passing across the cavity, unite with others of the same kind, and form so many distinct bags, which communicate with each other; and these again are subdivided into communicating vesicular cells, in which the marrow is contained.

The Marrow is the oily part of the blood, separated by small arteries, and deposited in these cells. Its colour and consistence may therefore vary according to the state of the vessels, and their distribution on the membranes of the cells.

Besides the arteries already mentioned as being sent from the bones to the marrow, there is at least one artery for each bone; several bones have more, whose principal use is to convey and secern this oily matter.

The

The blood, which remains after the ſecretion of the marrow, is returned by proper veins, which are collected from the membranes into one or two large trunks, to paſs out at the ſame holes at which the arteries enter.

The veſſels of the marrow, wrapt up in one common coat from the perioſteum, paſs through the bones by proper canals; the moſt conſiderable of which are about the middle of each bone, and are very oblique.

From the ſtructure of the contents of the bones, we may judge how theſe parts, as well as others, may be ſubject to oidema, phlegmon, eryſipelas, ſchirrhus, *&c.* and may thence be led to a cure of each, before the common conſequence, putrefaction, takes place, and frequently occaſions the loſs of the limb, if not of the patient.

The marrow is of very conſiderable uſe to the bones; for by entering their tranſverſe canals, and paſſing from them into the longitudinal ones, it is communicated to all the plates, to ſoften and connect their fibres, whereby they are preſerved from becoming too brittle.

When the marrow, after having ſerved the uſes mentioned, is reaſſumed into the maſs of blood, it corrects the too great acrimony communicated to the ſaline particles of our fluids by their circulation and heat; in the ſame manner as lixivial ſalts are blunted by oil in making ſoap.

Since it is the nature of all oil to become thin and rancid when expoſed long to heat, and bones have much oil in their firm hard ſubſtance, we may know why an ungrateful ſmell, and dark-coloured thin ichor, proceed more from corrupted bones than from other parts of the body; and we can underſtand the reaſon of the changes of colour which bones undergo, according to their different degrees of mortification.

Though bones ſo far agree in their ſtructure and annexed parts, yet we may obſerve a conſiderable difference among them in their magnitude, figure, ſituation, ſubſtance, connection, uſes, *&c.* Of theſe we ſhall only mention two, *viz.* that ſome bones are *broad* and *flat*, while others are *long* and *round*.

The *broad* bones have thin ſides, by the plates being ſoon and equally ſent off to form the lattice-work; which therefore is thicker, and nearly of an equal form all through. By this ſtructure, they are well adapted to their uſes, of affording a large enough ſurface for the muſcles to riſe from, and move upon, and of defending ſufficiently the parts which they incloſe.

The *round* bones have thick ſtrong walls in the middle, and become very thin towards their ends, which is owing to very few plates ſeparating at their middle; where, on that account, the cancelli are ſo fine and ſmall that they are not taken notice of: But ſuch bones are ſaid to have a large reſervoir of oil in this place. Towards their ends the lattice-work becomes very thick, and rather more complete than in the other ſort of bones.—Theſe round bones having ſtrong forces naturally applied to them, and being otherwiſe expoſed to violent injuries, have need of a cylindrical figure to reſiſt external preſſure, and of a conſiderable quantity of oil to preſerve them from becoming too brittle. Beſides which, they are advantageouſly provided with thick ſides towards their middle, where the greateſt forces are applied to injure them; while their hollowneſs increaſes their diameter, and conſequently their ſtrength, to reſiſt forces applied to break them tranſverſely.

Many bones have protuberances, or proceſſes, riſing out from them. If a proceſs ſtands out in a roundiſh ball, it is called *caput*, or *head*.—If the head is flatted, it obtains the appellation of *condyle*.——A rough unequal protuberance is called *tuberoſity*.——When a proceſs riſes narrow, and then becomes large, the narrow or ſmall part is named *cervix*, or *neck*.——Long ridges of bones are called *ſpines*.——Such proceſſes as terminate in a ſharp point, have the general name of *coronæ*, or *coronoid*, beſtowed on them, though moſt of them receive particular names from the reſemblance they have, or are imagined to have, to other ſubſtances, *e. g. maſtoid*, *ſtyloid*, &c.——Such proceſſes as form brims of cavities, are called *ſupercilia*.

Proceſſes ſerve for the advantageous origin and inſertion of muſcles, and render the articulations firm and ſtable.

In children theſe proceſſes are real epiphyſes, or diſtinct bones, which are afterwards united to the other parts; ſuch are the ſtyloid proceſſes of the temporal bones, proceſſes of the vertebræ, trochanters of the thigh, *&c.*

On the ſurfaces of a great many of the bones there are cavities, or depreſſions: If theſe are deep, with large brims, authors name them *cotylæ*; if they are ſuperficial, they obtain the deſignation of *glenæ*, or *glenoid*. Theſe general claſſes are again divided into ſeveral ſpecies:—Of which *pits* are ſmall roundiſh channels ſunk perpendicularly into the bone;—*furrows* are long narrow canals, formed in the ſurface;—*nitches* or *notches*, ſmall breaches in the bone;—*ſinuoſities*, broad, but ſuperficial depreſſions without brims;—*foſſæ*, large deep cavities, which are not equally ſurrounded by high brims;—*ſinuſes*, large cavities within the ſubſtance of the bones, with ſmall apertures;—*foramina*, or holes, canals that pierce quite through the ſubſtance of the bones.——When this laſt ſort of cavity is extended any long way within a bone, the middle part retains the name of *canal*, and its ends are called *holes*.

The cavities allow the heads of bones to play in them; they lodge and defend other parts; they afford ſafe paſſage to veſſels, muſcles, *&c.*

To far the greater number of bones, whoſe ends are not joined to other bones by an immoveable articulation, there are ſmaller ones annexed, which afterwards become ſcarce diſtinguiſhable from the ſubſtance of the bone itſelf. Theſe are called *epiphyſes*, or *appendices*. Some bones have one, others have two, three, or four of theſe appendices annexed by the means of cartilages, which are of a conſiderable thickneſs in children, but by age become thinner.

Several proceſſes (*e. g. trochanters* of the thigh, *ſpine* of the *ſcapula*, &c.) have epiphyſes; and proceſſes frequently riſe out from epiphyſes; for example, at the lower end of the femur, ulna, tibia, *&c.*

The epiphyſes are united chiefly to ſuch bones as are deſtined for frequent and violent motion; and for this purpoſe they are wiſely framed of a larger diameter than the

the bone they belong to; for by this means, the furface of contact between the two bones of any articulation being increafed, their conjunction becomes firmer, and the mufcles inferted into them act with greater force, by reafon of their axes being further removed from the center of motion.

The foftnefs of the ends of bones may be of fome advantage in the womb, and at birth, after which the offification begins at different points to form epiphyfes, before the offification can extend from the middle to the ends of the bones.

However folid and compact adult bones are, yet they were once cartilages, membranes, nay, a mere jelly. This needs no further proof, than repeated obfervations of embryos when diffected: And how much more tender muft the bones be before that time, when neither knife nor eye is capable to difcover the leaft rudiments of them? By degrees they become more folid, then affume the nature of griftles, and at laft offify; the cohefion of their plates and fibres always increafing in proportion to their increafed folidities; as is evident from the time neceffary to unravel the texture of bones of people of different ages, or of denfe and of fpongy bones, or of the different parts of the fame bone, and from the more tedious exfoliations of the bones of adults than of children.

The offification of bones depends principally on their veffels being fo difpofed, and of fuch diameters, as to feparate a liquor, which may eafily turn into a bony fubftance, when it is deprived of its thinner parts; as feems plain from the obfervation of the callous matter feparated after fractures and ulcers, where part of the bone is taken out: For in thefe cafes, the veffels extending themfelves, and the liquors added to them, are gradually formed into granulated flefh; which fills up all the fpace where the bone is taken from, then hardens, till it becomes as firm as any other part of the bone. This happens frequently, even when the ends of the difeafed bone are at a confiderable diftance from each other.

The induration of bones is alfo greatly affifted by their being expofed, more than any other parts, to the ftrong preffure of the great weights they fupport, to the violent contraction of the mufcles fixed to them, and to the force of the parts they contain, which endeavour to make way for their own further growth. By all this preffing force, the folid fibres and veffels of bones are thruft clofer; and fuch particles of the fluids conveyed in thefe veffels as are fit to be united to the fibres, are fooner and more firmly incorporated with them, while the remaining fluids are forcibly driven out by the veins, to be mixed with the mafs of blood. In confequence of this, the veffels gradually diminifh as the bones harden. From which again we can underftand one reafon, why the bones of young animals fooner re-unite after a fracture than thofe of old; and why cattle that are put too foon to hard labour, feldom are of fuch large fize as others of the fame brood, who are longer kept from labour.

From the effects of preffure only it is, that we can account for the bones of old people having their fides much thinner, yet more denfe and folid, while the cavities are much larger than in thofe of young people; and for the prints of mufcles, veffels, *&c.* being fo much more ftrongly marked on the furfaces of the former than of the latter, if they belong to people of near the fame condition in life.—Preffure muft likewife be the caufe, which, in people of equal ages, makes thefe prints ftronger in the bones of thofe who had much labour and exercife, than they are in people who have led an indolent unactive life.

Having thus confidered the bones when fingle, we fhall next fhew the different manner of their conjunctions. To exprefs thefe, anatomifts have contrived a great number of technical terms; about the meaning, propriety, and claffing of which, there has been a variety of opinions. Some of thefe terms it is neceffary to retain, fince they ferve to exprefs the various circumftances of the articulations, and to underftand the writers on this fubject.

The Articulations are moft commonly divided into three claffes, *viz.* fymphyfis, fynarthrofis, and diarthrofis.

Symphyfis, which properly fignifies the concretion or growing together of parts, when ufed to exprefs the articulations of bones, does not feem to comprehend, under the meaning generally given to it, any thing relating to the form or motion of the conjoined bones; but by it moft authors only denote the bones to be connected by fome other fubftance; and as there are different fubftances which ferve this purpofe, therefore they divide it into the three following fpecies:

1. *Synchondrofis*, when a cartilage is the connecting fubftance: Thus the ribs are joined to the fternum; thus the bodies of the vertebræ are connected to each other; as are likewife the offa pubis.

2. *Synneurofis*, or *fyndefmofis*, when ligaments are the connecting bodies, as they are in all the moveable articulations.

3. *Syffarcofis*, when mufcles are ftretched from one bone to another, as they muft be where there are moveable joints.

The *fecond* clafs of articulations, the *fynarthrofis*, which is faid to be the general term by which the immoveable conjunction of bones is expreffed, is divided into three kinds.

1. The *future* is that articulation where two bones are mutually indented into each other, or as if they were fewed together. Thus the bones of the head are joined; thus epiphyfes are joined to the bones, before their full connection and union with them.

2. *Gomphofis* is the fixing one bone into another, as a nail is fixed in a board: Thus the teeth are fecured in their fockets.

3. *Schindylefis*, or ploughing, when a thin lamella of one bone is received into a long narrow furrow of another: Thus the proceffus azygos of the fphenoid, and the nafal procefs of the ethmoid bone, are received by the vomer.

The *third* clafs, or *diarthrofis*, is the articulation where the bones are fo loofely connected as to allow large motion. This is fubdivided into three kinds.

The

The firſt is *enarthroſis*, or the ball and ſocket, when a large head is received into a deep cavity; as the head of the os femoris is into the acetabulum coxendicis.

The ſecond is *arthrodia*, when a round head is received into a ſuperficial cavity; as in the articulation of the arm-bone and ſcapula. Theſe two ſpecies of diarthroſis allow motion to all ſides.

The third is *ginglimus*, which properly ſignifies the hinge of a door or window; in it the parts of the bones mutually receive and are received, and allow of motion two ways: Workmen call it *charnal*.

The ginglimus is generally divided into three kinds, to which ſome give the names of *contiguous*, *diſtant*, and *compound*.

The firſt kind of ginglimus is, when a bone has ſeveral protuberances and cavities, which anſwer to as many cavities and proceſſes of the other bone, with which it is articulated; as in the conjunction of the femur with the tibia.

The ſecond ſpecies is, when a bone receives another at one end, and is received by the ſame bone at the other end; as in the radius and ulna.

The laſt ſort is, when a bone receives another, and is received by a third; as in the oblique proceſſes of the vertebræ.

If the moveable bones are not connected and kept firm by ſome ſtrong ſubſtance, they would be luxated at every motion of the joints: and if their hard, rough, unequal ſurfaces were to play on each other, their motion would not only be difficult, but the loſs of ſubſtance from attrition would be great. Therefore *ligaments* are made to obviate the firſt, and *cartilages* to prevent the other inconveniency. But becauſe ligaments and cartilages turn rigid, inflexible, and rough, unleſs they are kept moiſt, a ſufficient quantity of proper liquor is ſupplied for their lubrication, and to preſerve them in a flexible ſtate. Seeing then theſe parts are ſo neceſſary to the articulations, we ſhall next conſider their ſtructure, ſituation, and uſes, ſo far as they are ſubſervient to the bones, and their motions.

Ligaments are white flexible bodies, thicker and firmer than membranes, and not ſo hard or firm as cartilages, without any remarkable cavity in their ſubſtance, difficultly ſtretched, and with little elaſticity; ſerving to connect one part to another, or to prevent the parts to which they are fixed from being removed out of that ſituation which is uſeful and ſafe.

After maceration in water, the ligaments can eaſily be divided; and each ligamentous layer appears compoſed of fibres, the largeſt of which are diſpoſed in a longitudinal direction.

The arteries of ligaments are very conſpicuous after a tolerable injection, and the larger trunks of their veins are ſometimes to be ſeen full of blood

Such ligaments as form the ſides of cavities, have numerous orifices of their arteries opening upon their internal ſurface, which keep it always moiſt: If we rub off that moiſture, and then preſs the ligament, we can ſee the liquor ouzing out from ſmall pores; and we can force thin liquors, injected by the arteries, into the cavities formed by ligaments.

Theſe exhalent arteries muſt have correſponding abſorbent veins, otherwiſe the cavities would ſoon be too full of liquor.

Ligaments then muſt be ſubject to the diſeaſes common to other parts, where there is a circulation of fluids, allowance always being made for the ſize of veſſels, nature of the fluids, and firmneſs of the texture of each part.

Some authors have alledged, that ligaments are inſenſible, and conſequently that they have no nerves. But the violent racking pain felt on the leaſt motion of a joint labouring under a rheumatiſm, the ſeat of which diſeaſe ſeems often to be in the ligaments, and the inſufferable torture occaſioned by inciſions of ligaments, and by a collection of acrid matter in a joint, or by tophi in the gout, would perſuade us, that they are abundantly ſupplied with nerves.

The ligaments which connect the moveable bones commonly riſe from the conjunction of the epiphyſes of the one bone, and are inſerted into the ſame place of the other; or where epiphyſes are not, they come out from the cervix, and beyond the ſupercilia of the articulated bones; and after ſuch a manner, in both caſes, as to include the articulation in a purſe or bag; with this difference, depending on their different motions, that where the motion is only to be in two directions, the ligaments are ſtrongeſt on thoſe ſides towards which the bones are not moved; and when a great variety of motions is deſigned to be allowed, the ligaments are weaker than in the former ſort of articulations, and are nearly of the ſame ſtrength all round.

Part of the capſular ligaments is compoſed of the perioſteum, continued from one bone to another, and their internal layer is continued on the parts of the bone or cartilage which the ligament includes.

Beſides theſe common capſular ligaments of the joints, there are particular ones in ſeveral places, either for the firmer connection of the articulated bones, or for reſtraining and confining the motion to ſome one ſide; ſuch are the croſs and lateral ligaments of the knee, the round one of the thigh, *&c.*

From this account of the ligaments, we may conclude, that, *cæteris paribus*, in whatever articulation the ligaments are few, long, and weak, the motion is more free and quick; but luxations happen frequently: And, on the contrary, where the ligaments are numerous, ſhort, and ſtrong, the motion is more confined; but ſuch a joint is leſs expoſed to luxations.—Whence we may judge how neceſſary it is to attend to the different ligaments, and the changes which have been made on them by a luxation, when it is to be reduced.

Ligaments alſo ſupply the place of bones in ſeveral caſes to advantage: Thus the parts in the pelvis are more ſafely ſupported below by ligaments, than they could have been by bone.—The ligaments placed in the great holes of the oſſa innominata, and between the bones of the fore-arm and leg, afford convenient origin to muſcles.—Immoveable bones are firmly connected by them;

of which the conjunction of the os facrum and innominatum is an example.—They afford a focket for moveable bones to play in, as we fee part of the aftragalus does on the ligament ftretched from the heel-bone to the fcaphoid.

Numerous inconveniencies may arife from too long or fhort, ftrong or weak, lax or rigid ligaments.

Cartilages are folid, fmooth, white elaftic fubftances, between the hardnefs of bones and ligaments, and covered with a membrane, named *perichondrium*, which is of the fame ftructure and ufe to them as the periofteum is to the bones.

Cartilages are compofed of plates, which are formed of fibres, difpofed much in the fame way as thofe of bones are; as might be reafonably concluded from obferving bones in a cartilaginous ftate before they offify, and from feeing, on the other hand, fo many cartilages become bony. This may be ftill further confirmed, by the exfoliation which cartilages are fubject to, as well as bones.

The perichondrium of feveral cartilages, for example, thofe of the ribs and larynx, has arteries which can be equally well injected with thofe of the perioftcum.

The granulated flefh which rifes from the ends of metacarpal or metatarfal bones, when the cartilage exfoliates, after a finger or toe has been taken off at the firft joint, is very fenfible, from which the exiftence of nerves in cartilages may be inferred.

While cartilages are in a natural ftate, it is to be remarked, firft, That they have no cavity in their middle for marrow. Secondly, That their outer furface is fofteft, which renders them more flexible. Thirdly, That they do not appear to change their texture near fo much by acids as bones do. And, laftly, That as the fpecific gravity of cartilages is near a third lefs than that of bones, fo the cohefion of their feveral plates is not fo ftrong as in bones; whence cartilages laid bare in wounds or ulcers, are not only more liable to corrupt, but exfoliate much fooner than bones do.

Cartilages feem to be principally kept from offifying, either by being fubjected to alternate motions of flexion and extenfion, the effects of which are very different from any kind of fimple preffure, or by being conftantly moiftened: Thus, the cartilages on the articulated ends of the great bones of the limbs, and the moveable ones placed between the moving bones in fome articulations, which are obliged to fuffer many and different flexions, and are plentifully moiftened, fcarce ever change into bone; while thofe of the ribs and larynx are often offified.

The cartilages fubfervient to bones, are fometimes found on the ends of bones which are joined to no other; but are never wanting on the ends, and in the cavities of fuch bones as are defigned for motion.

The ufes of cartilages, fo far as they regard bones, are, to allow, by their fmoothnefs, fuch bones as are defigned for motion, to flide eafily without detrition, while, by their flexibility, they accommodate themfelves to the feveral figures neceffary in different motions, and, by their elafticity, they recover their natural pofition and fhape as foon as the preffure is removed.——This fpringy force may alfo affift the motion of the joint to be more expeditious, and may render fhocks in running, jumping, *&c.* lefs.——To thefe cartilages we chiefly owe the fecurity of the moveable articulations: For without them the bony fibres would fprout out, and intimately coalefce with the adjoining bone; whence a true anchylofis muft neceffarily follow; which never fails to happen when the cartilages are eroded by acrid matter, or offified from want of motion or defect of liquor, as we fee often happens after wounds of the joints, paidarthrocace, fcrophula, and fpina ventofa, or from old age, and long immobility of joints. The moveable cartilages interpofed in joints, ferve to make the motions both freer and more fafe than they would otherwife be. ——Thofe placed on the ends of bones that are not articulated, as on the fpine of the os illium, bafe of the fcapula, *&c.* ferve to prevent the bony fibres from growing out too far.——Cartilages fometimes ferve as ligaments, either to faften together bones that are immoveably joined, fuch are the cartilages between the os facrum and offa illium, the offa pubis, *&c.* or to connect bones that enjoy manifeft motion, as thofe do which are placed between the bodies of the true vertebræ, *&c.*—Cartilages very often do the office of bones to greater advantage, than thefe laft could, as in the cartilages of the ribs, thofe which fupply brims to cavities, *&c.*

Too great thicknefs or thinnefs, length or fhortnefs, hardnefs or fupplenefs of cartilages, may therefore caufe great diforders in the body.

The liquor, which principally ferves to moiften the ligaments and cartilages of the articulations, is fupplied by glands, which are commonly fituated in the joint, after fuch a manner as to be gently preffed, but not deftroyed by its motion. By this means, when there is the greateft neceffity for this liquor, that is, when the moft frequent motions are performed, the greateft quantity of it muft be feparated. Thefe glands are foft and pappy, but not friable: In fome of the large joints they are of the conglomerate kind, or a great number of fmall glandules are wrapt up in one common membrane. Their excretory ducts are long, and hang loofe, like fo many fringes, within the articulation; which, by its motion and preffure, prevents obftructions in the body of the gland or its excretories, and promotes the return of this liquor, when fit to be taken up by the abforbent veffels, which muft be in the joints, as well as in the other cavities of the body; and, at the fame time, the preffure on the excretory ducts hinders a fuperfluous unneceffary fecretion, while the fimbriated difpofition of thefe excretories does not allow any of the fecreted liquor to be pufhed back again by thefe canals towards the glands.

Very often thefe fountains of flimy liquor appear only as a net-work of veffels.——Frequently they are almoft concealed by cellular membranes containing the fat;—and fometimes fmall fimple mucous folliculi may be feen.

The different joints have thefe organs in different numbers and fizes; the conglomerate ones don't vary much, efpecially as to fituation, in the fimilar joints of different bodies; but the others are more uncertain.

Upon preffing any of thefe glands with the finger, one can

can ſqueeze out of their excretories a mucilaginous liquor, which ſomewhat reſembles the white of an egg, or ſerum of the blood; but it is manifeſtly ſalt to the taſte. It does not coagulate by acids or by heat, as the ſerum does, but by the latter turns firſt thinner, and, when evaporated, leaves only a thin ſalt film.

The veſſels which ſupply liquors for making the ſecretion of this mucilage, and the veins which bring back the blood remaining after the ſecretion, are to be ſeen without any preparation; and, after a tolerable injection of the arteries, the glands are covered with them.

In a ſound ſtate, we are not conſcious of any ſenſibility in thoſe glands; but, in ſome caſes, when they inflame and ſuppurate, the moſt racking pain is felt in them: a melancholy, though a ſure proof that they have nerves.

Theſe mucilaginous glands are commonly lodged in a cellular ſubſtance; which is alſo to be obſerved in other parts of the bag formed by the ligaments of the articulation; and contains a fatty matter, that muſt neceſſarily be attenuated, and forced through the including membranes into the cavity of the joint, by the preſſure which it ſuffers from the moving bones.

After the liquor of the articulations becomes too thin and unſerviceable, by being conſtantly pounded and rubbed between the moving bones, it is reaſſumed into the maſs of blood by the abſorbent veſſels.

SECT. II. *Of the* SKELETON.

AMONG anatomiſts, *Skeleton* is univerſally underſtood to ſignify the bones of animals connected together, after the teguments, muſcles, bowels, glands, nerves, and veſſels are taken away.

A ſkeleton is ſaid to be a natural one, when the bones are kept together by their own ligaments; and it is called *artificial*, when the bones are joined with wire, or any other ſubſtance which is not part of the creature to which they belonged.

The human ſkeleton is generally divided into the HEAD, the TRUNK, the SUPERIOR and the INFERIOR EXTREMITIES.

OF THE HEAD.

BY the *Head* is meant all that ſpheroidal part which is placed above the firſt bone of the neck. It therefore comprehends the cranium and bones of the face.

The cranium, helmet, or brain-caſe, conſiſts of ſeveral pieces, which form a vaulted cavity, for lodging and defending the brain and cerebellum, with their membranes, veſſels, and nerves.

The cavity of the cranium is proportioned to its contents. Hence ſuch a variety of its ſize is obſerved in different ſubjects; and hence it is neither ſo broad nor ſo deep at its fore-part, in which the anterior lobes of the brain are lodged, as it is behind, where the large poſterior lobes of the brain, and the whole cerebellum, are contained.

The external ſurface of the upper part of the cranium is very ſmooth, and equal, being only covered with the perioſteum, (common to all the bones; but in the ſkull, diſtinguiſhed by the name of pericranium), the thin frontal and occipital muſcles, their tendinous aponeuroſis, and with the common teguments of the body; while the external ſurface of its lower part has numerous riſings, depreſſions, and holes, which afford convenient origin and inſertion to the muſcles that are connected to it, and allow ſafe paſſage for the veſſels and nerves that run through and near it.

The internal ſurface of the upper part of the ſkull is commonly ſmooth, except where the veſſels of the dura mater have made furrows in it, while the bones were ſoft.——Surgeons ſhould be cautious when they trepan here, leſt, in ſawing or raiſing the bone where ſuch furrows are, they wound theſe veſſels.——In the upper part of the internal ſurface of ſeveral ſkulls, there are likewiſe pits of different magnitudes and figures, which ſeem to be formed by ſome parts of the brain being more luxuriant and prominent than others. Where theſe pits are, the ſkull is ſo much thinner than any where elſe, that it is often rendered diaphanous, the two tables being cloſely compacted without a diploe; the want of which is ſupplied by veſſels going from the dura mater into a great many ſmall holes obſervable in the pits.——The knowledge of theſe pits ſhould teach ſurgeons to ſaw cautiouſly and ſlowly through the external table of the ſkull, when they are performing the operation of the trepan; ſince, in a patient whoſe cranium has theſe pits, the dura mater and brain may be injured, before the inſtrument has pierced near the ordinary thickneſs of a table of the ſkull.——The internal baſe of the ſkull is extremely unequal for lodging the ſeveral parts and appendices of the brain and cerebellum, and allowing paſſage and defence to the veſſels and nerves that go into, or come out from theſe parts.

The bones of the cranium are compoſed of two tables, and intermediate cancelli, commonly called their *diploe*. The external table is thickeſt; the inner, from its thinneſs and conſequent brittleneſs, has got the name of *vitrea*.

The diploe has much the ſame texture and uſes in the ſkull, as the cancelli have in other bones.

The diploe of ſeveral old ſubjects is ſo obliterated, that ſcarce any veſtige of it can be ſeen; neither is it obſervable in ſome of the hard craggy bones at the baſe of the ſkull. Hence an uſeful caution to ſurgeons who truſt to the bleeding, want of reſiſtance, and change of ſound, as certain marks, in the operation of the trepan, for knowing when their inſtrument has ſawed through the firſt table, and reached the diploe.

The cranium conſiſts of eight bones, ſix of which are ſaid to be proper, and the other two are reckoned common to it and to the face.—The ſix proper are, the os frontis, two oſſa parietalia, two oſſa temporum, and the os occipitis.——The common are, the os ethmoides, and ſphenoides.

The os frontis forms the whole fore-part of the vault; the two oſſa parietalia form the upper and middle part of it; the oſſa temporum compoſe the lower part of the ſides;

fides; the os occipitis makes the whole hinder-part, and fome of the bafe; the os ethmoides is placed in the fore-part of the bafe; and the os fphenoides is in the middle of it.

Thefe bones are joined to each other by five futures; the names of which are, the coronal, lambdoid, fagittal, and two fquamous.

The coronal future is extended over the head, from within an inch or fo of the external canthus of one eye, to the like diftance from the other; which being near the place where the ancients wore their vittæ, coronæ, or garlands, this future has hence got its náme.—Though the indentations of this future are confpicuous in its upper part, yet an inch or more of its end on each fide has none of them; for it is fquamous and fmooth there.

The lambdoidal future begins fome way below, and farther back than the vertex or crown of the head, whence its two legs are ftretched obliquely downwards, and to each fide, in the form of the Greek letter Λ, and are generally faid to extend themfelves to the bafe of the fkull.

This future is fometimes very irregular, being made up of a great many fmall futures, which furround fo many little bones that are generally larger and more confpicuous on the external furface of the fkull than internally. Thefe bones are generally called *triquetra*, or *Wormiana*.

The fagittal future is placed longitudinally, in the middle of the upper part of the fkull, and commonly terminates at the middle of the coronal, and of the lambdoid futures; between which it is faid to be placed, as an arrow is between the ftring and bow.—However, this future is frequently continued through the middle of the os frontis, down to the root of the nofe; which oftener happens in women than men.

The fquamous agglutinations, or falfe futures, are one on each fide, a little above the ear, of a femicircular figure, formed by the overlopping (like one fcale upon another) of the upper part of the temporal bones, on the lower part of the parietal, where, in both bones, there are a great many fmall rifings and furrows, which are indented into each other; though thefe inequalities do not appear till the bones are feparated

The bones of the fkull are joined to thofe of the face by fchyndelefis and futures.—The fchyndelefis is in the partition of the nofe.—The futures faid to be common to the cranium and face are five, *viz.* the ethmoidal, fphenoidal, tranfverfe, and two zygomatic.—Parts however of thefe futures are at the junction of only the bones of the fkull.

The ethmoidal and fphenoidal futures furround the bones of thefe names; and in fome places help to make up other futures, particularly the fquamous and tranfverfe; and, in other parts, there is but one future common to thefe two bones.

The tranfverfe future is extended quite crofs the face, from the external canthus of one orbit, to the fame place of the other.

The zygomatic futures are one on each fide, being fhort, and flanting from above obliquely, downwards and backwards, to join a procefs of the cheek-bone to one of the temporal bones, which advances towards the face; fo that the two proceffes thus united, form a fort of bridge or jugum, under which the temporal mufcle paffes; on which account the proceffes, and futures joining them, have been called *zygomatic*.

The advantages of the futures of the cranium are thefe: 1. That this capfula is more eafily formed and extended into a fpherical figure, than if it had been one continued bone. 2. That the bones which are at fome diftance from each other at birth might then yield, and allow to the head a change of fhape, accommodated to the paffage it is engaged in. Whence, in hard labour of child-bed, the bones of the cranium, inftead of being only brought into contact, are fometimes made to mount one upon the other. 3. That the dura mater may be more firmly fufpended by its proceffes, which infinuate themfelves into this conjunction of the bones; for doing this equally, and where the greateft neceffity of adhefion is, the futures are difpofed at nearly equal diftances, and the large refervoirs of blood, the finufes, are under or near them. 4. That fractures might be prevented from reaching fo far as they would in a continued bony fubftance. 5. That the connection at the futures being capable of yielding, the bones might be allowed to feparate; which has given great relief to patients from the violent fymptoms which they had before this feparation happened.

Having gone through the general ftructure of the cranium, we now proceed to examine each bone of which that brain-cafe confifts.

The Os Frontis has its name from its being the only bone of that part of the face we call the forehead, though it reaches a good deal further. It has fome refemblance in fhape to the fhell of the concha bivalvis, commonly called the *cockle*; for the greateft part of it is convex externally, and concave internally, with a ferrated circular edge; while the fmaller part has proceffes and depreffions, which make it of an irregular figure.

The external furface of the os frontis is fmooth at its upper convex part; but feveral proceffes and cavities are obfervable below: for, at each angle of each orbit, the bone jutts out to form four proceffes, two internal, and as many external; which, from this fituation, may well enough be named *angular*. Between the internal and external angular proceffes of each fide, an arched ridge is extended, on which the eye-brows are placed.—Very little above the internal end of each of thefe fuperciliary ridges, a protuberance may be remarked, in moft fkulls, where there are large cavities, called *finufes*, within the bone.—Betwixt the internal angular proceffes, a fmall procefs rifes, which forms fome fhare of the nofe, and thence is named *nafal*.—Some obferve a protuberant part on the edge of the bone, behind each external angular procefs, which they call *temporal* proceffes; but thefe are inconfiderable.—From the under part of the fuperciliary ridges, the frontal bone runs a great way backwards; which parts may juftly enough be called *orbitar* proceffes. Thefe, contrary to the reft of this bone, are concave externally, for receiving the globes of the eyes, with their mufcles, fat, *&c.*

In each of the orbitar proceffes, behind the middle of the fuperciliary ridges, a confiderable finuofity is obferved, where

where the glandula innominata Galeni, or lachrymalis, is lodged.—Behind each internal angular procefs, a fmall pit may be remarked, where the cartilaginous pully of the mufculus obliquus major of the eye is fixed.—— Betwixt the two orbitar proceffes, there is a large difcontinuation of the bone, into which the cribriform part of the os ethmoides is incafed.—The frontal bone frequently has little caverns formed in it here where it is joined to the ethmoid bone.——Behind each external angular procefs, the furface of the frontal bone is confiderably depreffed where part of the temporal mufcle is placed.

The *foramina*, or holes, obfervable on the external furface of the frontal bone, are three in each fide.—— One in each fuperciliary ridge, a little removed from its middle towards the nofe; through which a twig of the ophthalmic branch of the fifth pair of nerves paffes out of the orbit, with a fmall artery, from the internal carotid, to be diftributed to the teguments and mufcles of the forehead.—Thefe veffels in fome fculls make furrows in the os frontis, efpecially in the bones of children; and therefore we ought to beware of tranfverfe incifions on either fide of the os frontis, which might either open thefe veffels or hurt the nerves, while they are yet in part within the bone; for, when veffels are thus wounded, it is difficult to ftop the hæmorrhagy, becaufe the adhefion of a part of the artery to the bone hinders its contraction, and confequently ftyptics can have little effect; the fides of the furrow keep off compreffing fubftances from the artery; and we would wifh to fhun cauteries or efcharotics, becaufe they make the bone carious; and nerves, when thus hurt, fometimes produce violent fymptoms.—But we muft remark, that often, inftead of a hole, a notch only is to be feen: Nay, in fome fkulls, fcarce a veftige even of this is left; in others, both hole and notch are obfervable, when the nerve and artery run feparately. Frequently a hole is found on one fide, and a notch on the other; at other times we fee two holes; or there is a common hole without, and two diftinct entries internally. Near the middle of the infide of each orbit, hard by, or in the tranfverfe future, there is a fmall hole for the paffage of the nafal twig of the firft branch of the fifth pair of nerves, and of a branch of the ophthalmic artery. This hole is fometimes entirely formed in the os frontis; in other fkulls, the fides of it are compofed of this laft bone, and of the os planum. It is commonly known by the name of *orbitarium internum*, though *anterius* fhould be added, becaufe of the next, which is commonly omitted. —This, which may be called *orbitarium internum pofterius*, is fuch another as the former; only fmaller, and about an inch deeper in the orbit: through it a fmall branch of the ocular artery paffes to the nofe.--Befides thefe fix, there are a great number of fmall holes obfervable on the outer furface of this bone, particularly in the two protuberances above the eye-brows. Moft of thefe penetrate no further than the finufes, or than the diploe, if the finufes are wanting. The place, fize, and number of them, are however uncertain: They generally ferve for the tranfmiffion of fmall arteries or nerves.

The internal furface of the os frontis is concave, except at the orbitar proceffes, which are convex, to fupport the anterior lobes of the brain. This furface is not fo fmooth as the external; for the larger branches of the arteries of the dura mater make fome furrows in its fides and back-parts. The finuofities from the luxuriant rifings of the brain, mentioned when defcribing the general ftructure of the cranium, are often very obfervable on its upper part; and its lower and fore parts are marked with the contorfions of the anterior lobes of the brain.——Through the middle of this internal furface, where always in children, and fometimes in old people, the bone is divided, either a ridge ftands out, to which the upper edge of the falx is faftened, or a furrow runs, in which the upper fide of the fuperior longitudinal finus is lodged; on both thefe accounts chirurgical authors juftly difcharge the application of the trepan here.

Immediately at the root of this ridge or furrow there is a fmall hole, which fometimes pierces through the firft table, and, in other fkulls, opens into the fuperior finus of the ethmoid bone within the nofe. In it a little procefs of the falx is lodged, and a fmall artery, and fometimes a vein, runs; and the fuperior longitudinal finus begins here.—This hole, however, is often not entirely proper to the os frontis; for in feveral fkulls, the lower part of it is formed in the upper part of the bafe of the crifta galli, which is a procefs of the ethmoid bone.

The os frontis is compofed of two tables, and an intermediate diploe, as the other bones of the cranium are, and in a middle degree of thicknefs between the os occipitis and the parietal bones.

The diploe is alfo exhaufted in that part above the eye-brows, where the two tables of the bone feparate, by the external being protruded outwards, to form two large cavities, called *finus frontales*.—Thefe are divided by a middle perpendicular bony partition.—In fome fkulls, befides the large perpendicular feptum, there are feveral bony pillars, or fhort partitions, found in each finus; in others thefe are wanting.—For the moft part the feptum is entire; at other times it is difcontinued, and the two finufes communicate.—Each finus commonly opens by a roundifh fmall hole, at the inner and lower part of the internal angular proceffes, into a finus formed in the nofe, at the upper and back part of the os unguis; near to which there are alfo fome other fmall finufes of this bone, the greater part of which open feparately nearer the feptum narium, and often they terminate in the fame common canal with the large ones.

In a natural and found ftate, thefe cavities are of confiderable advantage; for the organ of fmelling being thus enlarged, the effluvia of odorous bodies more difficultly efcape it; and their impreffions being more numerous, are therefore ftronger, and affect the organ more.—— Thefe and the other cavities which open into the nofe, increafe the found of our voice, and render it more melodious, by ferving as fo many vaults to refound the notes. Hence people labouring under a coryza, or ftoppage of the nofe from any other caufe, when they are by the vulgar, though falfely, faid to fpeak through their nofe, have fuch a difagreeable harfh voice.—The liquor feparated in the membrane of thefe finufes, drills down upon the membrane of the nofe to keep it moift.

From the defcription of thefe finufes, it is evident, how

how uselefs, nay, how pernicious it muft be, to apply a trepan on this part of the fkull; for this inftrument, inftead of piercing into the cavity of the cranium, would reach no further than the finufes.

The upper circular part of the os frontis is joined to the offa parietalia, from one temple to the other, by the coronal future. From the termination of the coronal future to the external angular proceffes, this bone is connected to the fphenoid by the fphenoidal future. At the external canthi of the eyes, its angular proceffes are joined by the tranfverfe future to the offa malarum, to which it adheres one third down the outfide of the orbits; whence to the bottom of thefe cavities, and a little up on their internal fides, thefe orbitar proceffes are connected to the fphenoidal bone by that fame future.—On the infide of each orbit, the orbitar procefs is indented between the cribriform part of the ethmoid bone, and the os planum and unguis.——The tranfverfe future afterwards joins the frontal bone to the fuperior nafal proceffes of the offa maxillaria fuperiora, and to the nafal bones. And, laftly, its nafal procefs is connected to the nafal lamella of the ethmoid bone.

The frontal bone ferves to defend and fupport the anterior lobes of the brain. It forms a confiderable part of the cavities that contain the globes of the eyes, helps to make up the feptum narium, organ of fmelling, *&c.* From the defcription of the feveral parts, the other ufes of this bone are evident.

In a ripe child, the frontal bone is divided through the middle; the fuperciliary holes are not formed; often a fmall round piece of each orbitar procefs, behind the fuperciliary ridge, is not offified, and there is no finus to be feen within its fubftance.

Each of the two Ossa Parietalia, or bones ferving as walls to the encephalon, is an irregular fquare; its upper and fore fides being longer than the one behind or below. The inferior fide is a concave arch; the middle part receiving the upper round part of the temporal bone.—The angle formed by this upper fide and the fore one, is fo extended, as to have the appearance of a procefs.

The external furface of each os parietale is convex. Upon it, fomewhat below the middle heighth of the bone, there is a tranfverfe arched ridge, of a whiter colour generally than any other part of the bone; from which, in bones that have ftrong prints of mufcles, we fee a great many converging furrows, like fo many radii drawn from a circumference towards a centre. From this ridge of each bone the temporal mufcle rifes; and, by the preffure of its fibres, occafions the furrows juft now mentioned.—Below thefe, we obferve, near the femicircular edges, a great many rifings and depreffions, which are joined to like inequalities on the infide of the temporal bone, to form the fquamous future. The temporal bone may therefore ferve here as a buttrefs, to prevent the lower fide of the parietal from ftarting outwards when its upper part is preffed or ftruck.

Near the upper fides of thefe bones, towards the hind part, is a fmall hole in each, through which a vein paffes from the teguments of the head to the longitudinal finus. —In feveral fkulls, one of the offa parietalia has not this hole; in others, there are two in one bone; and in fome not one in either. Moft frequently this hole is through both tables; at other times the external table is only perforated.—The knowledge of the courfe of thefe veffels may be of ufe to furgeons, when they make any incifion near this part of the head, left, if the veffels are rafhly cut near the hole, they fhrink within the fubftance of the bone, and fo caufe an obftinate hæmorrhagy, which neither ligatures nor medicines can ftop.

On the inner concave furface of the parietal bones, we fee a great many deep furrows, difpofed fomewhat like the branches of trees: The furrows are largeft and deepeft at the lower edge of each os parietale, efpecially near its anterior angle, where fometimes a full canal is formed. They afterwards divide into fmall furrows, in their progrefs upwards.—In fome fkulls a large furrow begins at the hole near the upper edge, and divides into branches, which join with thofe which come upwards, fhewing the communications of the upper and lower veffels of the dura mater.—In thefe furrows we frequently fee paffages into the diploe. On the infide of the upper edge of the offa parietalia, there is a large finuofity, frequently larger in the bone of one fide than of the other, where the upper part of the falx is faftened, and the fuperior longitudinal finus is lodged.—Generally part of the lateral finufes makes a depreffion near the angle, formed by the lower and pofterior fides of thefe bones; and the pits made by the prominent parts of the brain are to be feen in no part of the fkull more frequent, or more confiderable, than in the internal furface of the parietal bones.

The offa parietalia are amongft the thinneft bones of the cranium; but enjoy the general ftructure of two tables and diploe the completeft, and are the moft equal and fmooth.

Thefe bones are joined at their fore-fide to the os frontis by the coronal future; at their long inferior angles, to the fphenoid bone, by part of the future of this name; at their lower edge, to the offa temporum, by the fquamous future, and its pofterior additamentum; behind, to the os occipitis, or offa triquetra, by the lambdoid future; and above, to one another, by the fagittal future.

In a child born at the full time, none of the fides of this bone are completed; and there never is a hole in the offified part of it near to the fagittal future.

The large unoffified ligamentous part of the cranium obfervable between the parietal bones, and the middle of the divided os frontis of new-born children, called by the vulgar the *open of the head*, was imagined by the ancients to ferve for the evacuation of the fuperfluous moifture of the brain; and therefore they named it *bregma*, or the fountain; fometimes adding the epithet *pulfatilis*, or beating, on account of the pulfation of the brain felt through this flexible ligamento-cartilaginous fubftance. Hence very frequently the parietal bones are called *offa bregmatis*.

All the bregma is generally offified before feven years of age. Several authors fay, they have obferved it unoffified in adults; and phyficians, who order the application of medicines at the meeting of the coronal and fagittal

tal ſutures, ſeem yet to think that a derivation of noxious humours from the encephalon is more eaſily procured at this part than any other of the ſkull; and that medicines have a greater effect here, than elſewhere, in the internal diſorders of the head.

Ossa Temporum, ſo named, ſay authors, from the hair's firſt becoming grey on the temples, and thus diſcovering peoples ages, are each of them equal and ſmooth above, with a very thin ſemicircular edge; which, from the manner of its connection with the neighbouring bones, is diſtinguiſhed by the name of *os ſquamoſum*.—Behind this, the upper part of the temporal bone is thicker, and more unequal, and is ſometimes deſcribed as a diſtinct part, under the name of *pars mammillaris*.——Towards the baſe of the ſkull, the temporal bone appears very irregular and unequal; and this part, inſtead of being broad, and placed perpendicularly, as the others are, is contracted into an oblong very hard ſubſtance, extended horizontally forwards and inwards, which in its progreſs becomes ſmaller, and is commonly called *os petroſum*.

Three external proceſſes of each temporal bone are generally deſcribed.—The *firſt*, placed at the lower and hind-part of the bone, from its reſemblance to a nipple, is called *maſtoides*, or *mammillaris*. It is not ſolid, but within is compoſed of cancelli, or ſmall cells, which have a communication with the large cavity of the ear, the drum; and therefore ſounds, being multiplied in this vaulted labyrinth, are increaſed, before they are applied to the immediate organ of hearing. Into the maſtoid proceſs, the ſtenomaſtoideus muſcle is inſerted; and to its back-part, where the ſurface is rough, the trachelomaſtoideus, and part of the ſplenius are fixed.—About an inch farther forward, the *ſecond* proceſs begins to riſe out from the bone; and having its origin continued obliquely downwards and forwards for ſome way, it becomes ſmaller, and is ſtretched forwards to join with the os malæ; they together forming the bony jugum, under which the temporal muſcle paſſes. Hence this proceſs has been named *zygomatic*. Its upper edge has the ſtrong aponeuroſis of the temporal muſcle fixed into it; and its lower part gives riſe to a ſhare of the maſſeter.—The fore-part of the baſe of this proceſs is an oblong tubercle, which in a recent ſubject is covered with a ſmooth poliſhed cartilage, continued from that which lines the cavity immediately behind this tubercle.——From the under craggy part of the os temporum, the *third* proceſs ſtands out obliquely forwards. The ſhape of it is generally ſaid to reſemble the ancient ſtylus ſcriptorius; and therefore it is called the *ſtyloid* proceſs. Several muſcles have their origin from this proceſs, and borrow one half of their name from it; as *ſtylo-gloſſus*, *ſtylo-hyoideus*, *ſtylo-pharyngeus*: to it a ligament of the os hyoides is ſometimes fixed; and another is extended from it to the inſide of the angle of the lower jaw. This proceſs is often, even in adults, not entirely oſſified, but is ligamentous at its root, and ſometimes is compoſed of two or three diſtinct pieces.——Round the root of it, eſpecially at the fore-part, there is a remarkable riſing of the os petroſum, which ſome have eſteemed a proceſs; and, from the appearance it makes with the ſtyliform, have named it *vaginalis*.——Others again have, under the name of *auditory* proceſs, reckoned among the external proceſſes that ſemicircular ridge, which, running between the root of the maſtoid and zygomatic proceſſes, forms the under part of the external meatus auditorius.

The ſinuoſities or depreſſions on the external ſurface of each os temporum are theſe:——A long foſſa at the inner and back part of the root of the mammary proceſs, where the poſterior head of the digaſtric muſcle has its origin.—Immediately before the root of the zygomatic proceſs, a conſiderable hollow is left, for lodging the crotaphite muſcle.——Between the zygomatic, auditory, and vaginal proceſſes, a large cavity is formed; through the middle of which, from top to bottom, a fiſſure is obſervable, into which part of the ligament that ſecures the articulation of the lower jaw with this bone is fixed. The fore-part of the cavity being lined with the ſame cartilage which covers the tubercle before it, receives the condyle of the jaw; and in the back-part a ſmall ſhare of the parotid gland, and a cellular fatty ſubſtance, are lodged.—At the inſide of the root of the ſtyloid apophyſe, there is a thimble-like cavity, where the beginning of the internal jugular vein, or end of the lateral ſinus, is lodged.—Round the external meatus auditorius, ſeveral ſinuoſities are formed for receiving the cartilages and ligaments of the ear, and for their firm adheſion.

The holes that commonly appear on the outſide of each of theſe bones, and are proper to each of them, are five.—The *firſt*, ſituated between the zygomatic and maſtoid proceſſes, is the orifice of a large funnel-like canal, which leads to the organ of hearing; therefore is called *meatus auditorius externus*.——The *ſecond* gives paſſage to the portia dura of the ſeventh pair of nerves; and, from its ſituation between the maſtoid and ſtyloid proceſſes, is called *foramen ſtylo maſtoideum*.—Some way before, and to the inſide of the ſtyloid proceſs, is the *third* hole; the canal from which runs firſt upwards, then forwards, and receives into it the internal carotid artery, and the beginning of the intercoſtal nerve; where this canal is about to make the turn forwards, one, or ſometimes two very ſmall holes go off towards the cavity of the ear called *tympanum*: through theſe Valſalva affirms the proper artery or arteries of that cavity are ſent.—On the anterior edge of this bone, near the former, a *fourth* hole is obſervable, being the orifice of a canal which runs outwards and backwards, in a horizontal direction, till it terminates in the tympanum. This, in the recent ſubject, is continued forward and inward, from the parts which were mentioned juſt now as its orifice in the ſkeleton, to the ſide of the noſtrils: being partly cartilaginous, and partly ligamentous. The whole canal is named, *Iter a palato ad aurem*, or *Euſtachian tube*.—On the external ſide of the bony part of this canal, and a-top of the chink in the cavity that receives the condyle of the lower jaw, is the courſe of the little nerve ſaid commonly to be reflected from the lingual branch of the fifth pair, till it enters the tympanum, to run acroſs this cavity, and to have the name of *chorda tympani*.——The *fifth* hole is very uncertain, appearing ſometimes behind the maſtoid proceſs; ſometimes it is common to the temporal and occipital bones; and in ſeveral ſculls there is

is no ſuch hole. The uſe of it, when found, is for the tranſmiſſion of a vein from the external teguments to the lateral ſinus: But, in ſome ſubjects, a branch of the occipital artery paſſes through this hole, to ſerve the back-part of the dura mater.

The internal ſurface of the oſſa temporum is unequal; the upper circular edge of the ſquamous part having numerous ſmall ridges and furrows for its conjunction with the parietal bones; and the reſt of it is irregularly marked with the convolutions of the middle part of the brain, and with furrows made by the branches of the arteries of the dura mater.

From the under part of this internal ſurface, a larger tranſverſe, hard, craggy protuberance runs horizontally inwards and forwards, with a ſharp edge above, and two flat ſides, one facing obliquely forwards and outwards, and the other as much backwards and inwards. To the ridge between theſe two ſides, the large lateral proceſs of the dura mater is fixed.

Sometimes a ſmall bone, akin to the ſeſamoid, is found between the ſmall end of this petrous proceſs and the ſphenoid bone.

Towards the back-part of the inſide of the os temporum, a large deep foſſa is conſpicuous, where the lateral ſinus lies; and frequently on the top of the petrous ridge, a furrow may be obſerved, where a ſmall ſinus is ſituated.

The internal proper foramina of each of theſe bones are, firſt, the internal meatus auditorius in the poſterior plain ſide of the petrous proceſs. This hole ſoon divides into two; one of which is the beginning of the aquæduct of Fallopius: the other ends in ſeveral very ſmall canals, that allow a paſſage to the branches of the portio mollis of the ſeventh pair of nerves, into the veſtibule and cochlea. Through it alſo an artery is ſent, to be diſtributed to the organ of hearing.——The ſecond hole, which is on the anterior plain ſide of the craggy proceſs, gives paſſage to a reflected branch of the ſecond branch of the fifth pair of nerves, which joins the portio dura of the auditory nerve, while it is in the aquæduct, ſmall branches of blood-veſſels accompanying the nerves, or paſſing through ſmaller holes near this one.—The paſſage of the cutaneous vein into the lateral ſinus, or of a branch of the occipital artery, is ſeen about the middle of the large foſſa for that ſinus; and the orifice of the canal of the carotid artery is evident at the under part of the point of the petrous proceſs.

The upper round part of the ſquamous bones is thin, but equal; while the low petrous part is thick and ſtrong, but irregular and unequal, having the diſtinction of tables and diploe confounded, with ſeveral cavities, proceſſes, and bones within its ſubſtance, which are parts of the organ of hearing. See the deſcription of the bones, muſcles, *&c.* of the ear, in part VI.

The temporal bones are joined above to the parietal bones by the ſquamous ſutures, and their poſterior additamenta: Before, to the ſphenoid bone by the ſuture of that name; to the cheek-bones by the zygomatic ſutures: Behind, to the occipital bone, by the lambdoid ſuture and its additamenta; and they are articulated with the lower jaw in the manner which ſhall be deſcribed when this bone is examined.

Os Occipitis, ſo called from its ſituation, is convex on the outſide, and concave internally. Its figure is an irregular ſquare, or rather rhomboid; of which the angle above is generally a little rounded; the two lateral angles are more finiſhed, but obtuſe; and the lower one is ſtretched forward in form of a wedge, and thence is called by ſome the *cuneiform proceſs*.

The external ſurface is convex, except at the cuneiform apophyſe, where it is flatted. At the baſe of this triangular proceſs, on each ſide of the great hole, but more advanced forwards than the middle of it, the large oblong protuberances, named the *condyles*, appear, to ſerve for the articulation of this bone with the firſt vertebra of the neck. The ſmooth ſurface of each of theſe condyloid proceſſes is longeſt from behind forwards, where, by their oblique ſituation, they come much nearer to each other than they are at their back-part. Their inner ſides are lower than the external, by which they are prevented from ſliding to either ſide out of the cavities of the firſt vertebra.—Round their root a ſmall depreſſion and ſpongy roughneſs is obſervable, where the ligaments for ſurrounding and ſecuring their articulations adhere.—Though the motion of the head is performed on the condyles, yet the centre of gravity of that globe does not fall between them, but is a good way further forward; from which mechaniſm it is evident, that the muſcles which pull the head back muſt be in a conſtant ſtate of contraction: which is ſtronger than the natural contraction of the proper flexors, elſe the head would always fall forwards. as it does when a man is aſleep, or labours under a palſy, as well as in infants, where the weight of the head far exceeds the proportional ſtrength of theſe muſcles.

All round the great foramen the edges are unequal, for the firmer adheſion of the ſtrong circular ligament which goes thence to the firſt vertebra.—One end of each lateral or moderator ligament of the head, is fixed to a rough ſurface at the fore-part of each condyle, and the perpendicular one is connected to a rough part of the edge of the great hole between the two condyles.

On the inner ſurface of the os occipitis we ſee two ridges; one ſtanding perpendicular, the other running horizontally acroſs the firſt. The upper part of the perpendicular limb of the croſs, to which the falx is fixed, is hollowed in the middle, or often on one ſide, for the reception of the ſuperior longitudinal ſinus, and the lower part of it has the ſmall or third proceſs of the dura mater faſtened to it, and is ſometimes hollowed by the occipital ſinus. Each ſide of the horizontal limb is made hollow by the lateral ſiuuſes incloſed in the tranſverſe proceſs of the dura mater; the foſſa in the right ſide being generally a continuation of the one made by the longitudinal ſinus in the perpendicular limb, and therefore is larger than the left one.——Round the middle of the croſs there are four large depreſſions ſeparated by its limbs; the two upper ones being formed by the back-part of the brain, and the two lower ones by the cerebellum.——Farther forward than the laſt mentioned depreſſions,

preſſions, is the lower part of the foſſa for the lateral ſinus on each ſide.——The inner ſurface of the cuneiform apophyſe is made concave for the reception of the medulla oblongata, and of the baſilar artery.—A furrow is made on each ſide, near the edges of this proceſs, by a ſinus of the dura mater, which empties itſelf into the lateral ſinus.

The holes of this bone are commonly five proper, and two common to it and to the temporal bones.—The firſt of the proper holes, called *foramen magnum*, from its ſize, is immediately behind the wedge-like proceſs, and allows a paſſage to the medulla oblongata, nervi acceſſorii, to the vertebral arteries, and ſometimes to the vertebral veins.——At each ſide of this great hole, near its fore-part, and immediately above the condyles, we always find a hole, ſometimes two, which ſoon unite again into one that opens externally; through theſe the ninth pair of nerves go out of the ſkull.—The fourth and fifth holes pierce from behind the condyle of each ſide, into the foſſæ of the lateral ſinuſes; they ſerve for the paſſage of the cervical veins to theſe ſinuſes. Often one of theſe holes is wanting, ſometimes both, when the veins paſs through the great foramen.——Beſides theſe five, we frequently meet with other holes near the edges of this bone, for the tranſmiſſion of veins; but their number and diameter are very uncertain. The two common foramina are the large irregular holes, one in each ſide, between the ſides of the cuneiform proceſs, and the edges of the petrous bones. In a recent ſubject, a ſtrong membrane runs croſs from one ſide to the other of each of theſe holes.

The occipital bone is among the thickeſt of the cranium, though unequally ſo; for it is ſtronger above, where it has no other defence than the common teguments, than it is below, where, being preſſed by the lobes of the brain and cerebellum on one ſide, and, by the action of the muſcles on the other, it is ſo very thin, as to be diaphanous in many ſkulls.

The occipital bone is joined above to the oſſa parietalia and triquetra when preſent, by the lambdoid ſuture;—laterally to the temporal bones, by the additamenta of the lambdoid ſuture;—below to the ſphenoid bone, by the end of its cuneiform proceſs, in the ſame way that epiphyſes and their bones are joined.——The os occipitis is joined by a double articulation to the firſt vertebra of the neck, each condyle being received into a ſuperior oblique proceſs of that vertebra.

Os Ethmoides, or the ſieve-like bone, has got its name from the great number of ſmall holes with which that part of it firſt taken notice of is pierced. When this bone is entire, the figure of it is not eaſily deſcribed; but, by a detail of its ſeveral parts, ſome idea may be afforded of the whole; and therefore we ſhall diſtinguiſh it into the cribriform lamella with its proceſs, the naſal lamella, cellulæ, and oſſa ſpongioſa.

The thin horizontal lamella, is all (except its back-part) pierced obliquely by a great number of ſmall holes, through which the filaments of the olfactory nerves paſs.——From the middle of the internal ſide of this plate, a thick proceſs riſes upwards, and, being higheſt at the fore-part, gradually becomes lower, as it is extended backwards. From ſome reſemblance which this proceſs was imagined to have to a cock's comb, it has been called *criſta galli*. The falx is connected to its ridge, and to the unperforated part of the cribriform plate.——When the criſta is broke, its baſe is ſometimes found to be hollow, with its cavity opening into the noſe.

From the middle of the outer ſurface of the cribriform lamella, a thin ſolid plate is extended downwards and forwards, having the ſame common baſe with the criſta galli. Generally it is not exactly perpendicular, but is inclined to one ſide or other, and therefore divides the cavity of the noſe unequally. Its inclination to one ſide, and flexure in the middle, is ſometimes ſo great, that it fills up a large ſhare of one of the noſtrils, and has been miſtook for a polypus there.—It is thin at its riſe, and rather ſtill thinner in its middle; yet afterwards, towards its lower edge, it becomes thicker, that its conjunction with the bones and middle cartilage of the noſe might be firmer.

At a little diſtance from each ſide of this external proceſs, a cellular and ſpongy bony ſubſtance depends from the cribriform plate. The number and figure of the cells in this irregular proceſs of each ſide, are very uncertain; only the cells open into each other, and into the cavity of the noſe: The uppermoſt, which are below the aperture of the frontal ſinuſes, are formed like funnels.——The outer ſurface of thoſe cells is ſmooth and plain, where this bone aſſiſts in compoſing the orbit; at which place, on each ſide, it has got the name of *os planum;* on the upper edge of which, a ſmall notch or two may ſometimes be obſerved, which go to the formation of the internal orbitar holes.

Below the cells of each ſide, a thin plate is extended inwards, and then bending down, it becomes thick, and of a ſpongy texture.——This ſpongy part is triangular, with a ſtreight upper edge placed horizontally, an anterior one ſlanting from above, downwards and forwards, and with a pendulous convex one below.—The upper and lower edges terminate in a ſharp point behind.—The ſide of this pendulous ſpongy part next to the ſeptum narium is convex, and its external ſide is concave.——Theſe two proceſſes of the ethmoid bone have got the name of *oſſa ſpongioſa*, or *turbinata ſuperiora*, from their ſubſtance, figure, and ſituation.

All the prominencies, cavities and meanders of this ethmoid bone, are covered with a continuation of the membrane of the noſtrils, in a recent ſubject.——Its horizontal cribriform plate is lodged between the orbitar proceſſes of the frontal bone, to which it is joined by the ethmoid ſuture, except at the back-part, where it is connected with the cuneiform bone, by a ſuture common to both theſe bones.——Where the oſſa plana are contiguous to the frontal bone within the orbit, their conjunction is reckoned part of the tranſverſe ſuture.——Farther forward than the oſſa plana, the cells are covered by the oſſa unguis, which are not only contiguous to theſe cells, but cannot be ſeparated from them, without breaking the bony ſubſtance.—Below the oſſa unguis and plana, theſe cells and oſſa ſpongioſa are overlopped by the maxillary bones.——The cellular part of each palate-bone is contiguous to each os planum and cells backwards.—The

lower edge of the naſal perpendicular plate is received into the furrow of the vomer.——Its poſterior edge is joined to the fore-part of the proceſſus azygos of the ſphenoid bone.——Its upper edge joins the naſal proceſs of the frontal and naſal bones, and its anterior one is connected to the middle cartilage of the noſe.

From all which the uſes of this bone are evident, *viz.* to ſuſtain the anterior lobes of the brain; to give paſſage to the olfactory nerves, and attachment to the falx; to enlarge the organ of ſmelling, by allowing the membrane of the noſe a great extent; to ſtraiten the paſſage of the air through the noſe, by leaving only a narrow winding canal, on the ſenſible membranous ſides of which the ſubſtances conveyed along with the air muſt ſtrike, to form part of the orbit of the eyes and ſeptum narium; while all its parts are ſo light as not to be in hazard of ſeparating by their weight; and they are ſo thin, as to form a large ſurface, without occupying much ſpace.

Os Sphenoides, or wedge-like bone, ſo called becauſe of its ſituation in the middle of the bones of the cranium and face, is of an irregular figure, and bears ſome faint reſemblance to a bat with its wings extended.

When we view the external ſurface of the os ſphenoides, two or three remarkable proceſſes from each ſide of it may be obſerved; which are all of them again ſubdivided.——The firſt pair is the two large lateral proceſſes or wings; the upper part of each of which is called the *temporal proceſs*, becauſe they join with the temporal bones in forming the temples, and the ſeat for ſome ſhare of the crotaphite muſcles. That part of the wings which jutts out towards the inſide, ſomewhat lower than the temporal apophyſes, and is ſmooth and hollowed, where it makes up part of the orbit, is thence named *orbitar proceſſes*. Behind the edge ſeparating theſe two proceſſes, there is often a ſmall groove, made by a branch of the ſuperior maxillary nerve, in its paſſage to the temporal muſcle. The loweſt and back-part of each wing, which runs out ſharp to meet the oſſa petroſa, has been ſtyled the *ſpinous* proceſs: from near the point of which a ſharp pointed proceſs is frequently produced downwards, which ſome call *ſtyliform*, that affords origin to the ptery-ſtaphylinus externus muſcle. From this ſtyloid proceſs a very ſmall groove is extended along the edge of the bone to the hollow at the root of the internal plate of the following proceſſes, which forms part of the Euſtachian tube.—The ſecond pair of external proceſſes of the cuneiform bone is the two which ſtand out almoſt perpendicular to the baſe of the ſkull. Each of them has two plates, and a middle foſſa facing backwards, and are named *pterygoid* or *aliform* proceſſes. The external plates are broadeſt, and the internal are longeſt. From each ſide of the external plates, the pterygoid muſcles take their riſe. At the root of each internal plate, a ſmall hollow may be remarked, where the muſculus ptery-ſtaphylinus internus, or circumflexus palati, riſes, and ſome ſhare of the cartilaginous end of the Euſtachian tube reſts; and, at the lower end of the ſame plate, is a hook-like riſing or proceſs, round which the tendon of the laſt named muſcle plays, as on a pulley. ——To theſe another pair may be added, to wit, the little triangular thin proceſs, which comes from each ſide of the body of the ſphenoid bone, where the pterygoid proceſſes are riſing from it, and are extended over the lower part of the aperture of the ſinus, as far as to join the ethmoid bone, while their body hangs down into the nares.—Beſides theſe pairs of proceſſes, there is a ſharp ridge which ſtands out from the middle of its baſe: Becauſe it wants a fellow, it may be called *proceſſus azygos*. The lower part of this proceſs, where it is received into the vomer, is thick, and often not quite perpendicular, but inclining more to one ſide than the other. The fore-part of this proceſs, where it joins the naſal plate of the os ethmoides, is thin and ſtreight.

The depreſſions, ſinuoſities, and foſſæ, on the external ſurface of this ſphenoid bone, may be reckoned up to a great number, *viz.* two on the temporal apophyſes where the crotaphite muſcles lodge.—Two on the orbitar proceſſes, to make way for the globes of the eyes.——Two between the temporal and ſpinous proceſſes, for receiving the temporal bones.——Two between the plates of the pterygoid proceſſes, where the muſculi pterygoidei interni and ptery-ſtaphylini interni are placed.——Two between the pterygoid and orbitar proceſſes, for forming the holes common to this and to the cheek and maxillary bones.——Two on the lower ends of the aliform proceſſes, which the palate-bones enter into.——Two at the roots of the temporal and pterygoid proceſſes, where the largeſt ſhare of the external pterygoid muſcles have their riſe.——Two at the ſides of the proceſſus azygos, for forming part of the noſe, *&c.*

What was deſcribed under the name of *temporal* and *ſpinous proceſſes* on the outſide of the ſkull, are likewiſe ſeen on its inſide, where they are concave, for receiving part of the brain; and commonly three apophyſes on the internal ſurface of the ſphenoid bone are only mentioned. ——Two riſing broad from the fore-part of its body, become ſmaller, as they are extended obliquely backwards.——The third ſtanding on a long tranſverſe baſe, near the back-part of the body of this bone, riſes nearly erect, and of an equal breadth, terminating often in a little knob on each ſide. The three are called *clinoid*, from ſome reſemblance which they were thought to have to the ſupporters of a bed.——From the roots of the anterior clinoid proceſſes, the bone is extended on each ſide outwards and forwards, till it ends in a ſharp point, which may have the name of the *tranſverſe ſpinous* proceſſes.——Between, but a little farther back than the two anterior clinoid proceſſes, we ſee a protuberance conſiderably ſmaller than the poſterior clinoid proceſs, but of its ſhape.—Another proceſs from between the tranſverſe proceſſes, often forces itſelf forwards into the os ethmoides.

Within the ſkull, there are two ſinuoſities in the internal part of each wing of the ſphenoid bone, for receiving the middle part of the brain.——One between the tranſverſe ſpinous proceſſes, for lodging the part of the brain where the crura medullæ oblongatæ are.—Immediately before the third or middle clinoid proceſs, a ſingle pit generally may be remarked, from which a foſſa goes out on each ſide to the holes through which the optic nerves paſs. The pit is formed by the conjoined optic nerves; and in the foſſæ theſe nerves are lodged, as they

they run divided within the ſkull.—Between that third protuberance and the poſterior clinoid proceſs, the larger pit for the glandula pituitaria may be remarked. This cavity, becauſe of its reſemblance to a Turkiſh ſaddle, is always deſcribed under the name of *ſella Turcica*, or *ephippium*.——On the ſides of the poſterior clinoid proceſs a foſſa may be remarked, that ſtretches upwards, then is continued forwards along the ſides of the ſella Turcica, near to the anterior clinoid proceſſes, where a pit on each ſide is made. Theſe foſſæ point out the courſe of the two internal carotid arteries, after they have entered the ſkull.

The holes on each ſide of the *os ſphenoides* are ſix proper, and three common.——The *firſt* is the round one immediately below the anterior clinoid proceſſes, for the paſſage of the optic nerve, and of the branch of the internal carotid artery that is ſent to the eye.——The *ſecond* is the *foramen lacerum*, or large ſlit between the tranſverſe ſpinous and orbitar proceſſes: Through it the third, fourth, the firſt branch of the fifth, and the greater ſhare of the ſixth pair of nerves, and an artery from the internal carotid, go into the orbit. Sometimes a ſmall branch of the external carotid enters near its end, to be diſtributed to the dura mater, and a vein, ſome call it the *venous duct*, or *Nuck's aquæduct*, returns through it to the cavernous ſinus.——The *third* hole, ſituated a little below the one juſt now deſcribed, is called *rotundum*, from its ſhape. It allows paſſage to the ſecond branch of the fifth pair of nerves, or ſuperior maxillary nerve, into the bottom of the orbit.——The *fourth* is the *foramen ovale*, about half an inch behind the round hole. Through it the third branch of the fifth pair, or inferior maxillary nerve, goes out; and ſometimes a vein from the dura mater paſſes out here.——Very near the point of the ſpinous proceſs is the *fifth* hole of this bone: It is ſmall and round, for a paſſage to the largeſt artery of the dura mater, which often is accompanied with a vein.——The *ſixth* proper hole cannot be well ſeen, till the cuneiform bone is ſeparated from all the other bones of the cranium; for one end of it is hid by a ſmall protuberance of the internal plate of the pterygoid proceſs, and by the point of the proceſſus petroſus of the temporal bone. Its canal is extended above the inner plate of the pterygoid proceſs; and where it opens into the cavity of the noſe, it is concealed by the thin laminous part of the palate-bone. Through it a conſiderable branch of the ſecond branch of the *fifth* pair of nerves is reflected. ——Often in the middle of the *ſella Turcica*, a ſmall hole or two pierce as far as the cellular ſubſtance of the bone; and ſometimes at the ſides of this ſella, one or more ſmall holes penetrate into the ſphenoidal ſinuſes.

The *firſt* of the common holes is that unequal fiſſure at the ſide of the ſella Turcica, between the extreme point of the os petroſum and the ſpinous proceſs of the cuneiform bone.——The *ſecond* common hole is the large diſcontinuation of the external ſide of the orbit, left between the orbitar proceſſes of the cuneiform bone, the *os maxillare, malæ*, and *palati*. In this large hole the fat for lubricating the globe of the eye and temporal muſcle is lodged, and branches of the ſuperior maxillary nerve, with ſmall arteries from the carotid and veins, paſs. ——The *third* hole is formed between the baſe of this bone and the root of the orbitar proceſs of the palate-bone of each ſide. Through this a branch of the external carotid artery, and of the ſecond branch of the fifth pair of nerves, are allowed a paſſage to the noſtrils, and a returning vein accompanies them.

Under the ſella Turcica, and ſome way farther forward, but within the ſubſtance of the ſphenoid bone, are two ſinuſes, ſeparated by a bony plate. Each of them is lined with a membrane, and opens into the upper and back part of each noſtril by a round hole, which is at their upper fore-part. This hole is not formed only by the os ſphenoides, which has an aperture near as large as any tranſverſe ſection of the ſinus, but alſo by the palate-bones which are applied to the fore-part of theſe ſinuſes, and cloſe them up, that hole only excepted, which was already mentioned. Frequently the two ſinuſes are of unequal dimenſions, and ſometimes there is only one large cavity, with an opening into one noſtril.

As this bone is extremely ragged and unequal, ſo its ſubſtance is of very different thickneſs, being in ſome places diaphanous; in others it is of a middle thickneſs, and its middle back-part ſurpaſſes the greateſt ſhare of the cranium in thickneſs.

The os ſphenoides is joined, by its wings, to the parietal bones above, to the os frontis and oſſa malarum before, to the temporal bones behind;—by the fore-part of its body and ſpinous proceſſes, to the frontal and ethmoid bones;—by its back-part, behind the two ſinuſes, to the occipital, where it looks like a bone with the epiphyſes taken off;—to the palate-bones, by the ends of the pterygoid proceſſes, and ſtill more by the fore-part of the internal plates of the pterygoid proceſſes, and of the ſinuſes;—to the maxillary bones, by the fore-part of the external pterygoid plates;—to the vomer and naſal plate of the os ethmoides, by the proceſſus azygos. All theſe conjunctions, except the laſt, which is a ſchindyleſis, are ſaid to be by the ſuture proper to this bone; though it is at firſt ſight evident, that ſeveral other ſutures, as the tranſverſe, ethmoidal, *&c.* are confounded with it.

We ſee now how this bone is joined to all the bones of the cranium, and to moſt of the upper jaw; and therefore obtained the name of the *wedge-like bone*.

The Face is the irregular pile of bones, compoſing the fore and under part of the head, which is divided into the upper and lower maxillæ or jaws.

The *ſuperior maxilla* is the common deſignation given to the upper immoveable ſhare of the face. The ſhape of the ſuperior jaw cannot eaſily be expreſſed; nor is it neceſſary, provided the ſhape and ſituation of all the bones which compoſe it are deſcribed. It is bounded above by the tranſverſe ſuture, behind by the fore-part of the ſphenoid bone, and below by the mouth.

The upper jaw conſiſts of ſix bones on each ſide, of a thirteenth bone which has no fellow, placed in the middle, and of ſixteen teeth. The thirteen bones are, two *oſſa naſi*, two *oſſa unguis*, two *oſſa malarum*, two *oſſa maxillaria*, two *oſſa palati*, two *oſſa ſpongioſa inferiora*, and the *vomer*.

The

The offa nasi are placed at the upper part of the nose; —the offa unguis are at the internal canthi of the orbits; —offa malarum form the prominence of the cheeks;—offa maxillaria form the side of the nose, with the whole lower and fore part of the upper jaw, and the greatest share of the roof of the mouth;—offa palati are situated at the back-part of the palate, nostrils, and orbit;—offa spongiosa are seen in the lower part of the nares;—and the vomer helps to separate these two cavities.

The bones of the upper jaw are joined to the bones of the skull by the schindylesis and sutures already described as common to the cranium and face, and they are connected to each other by gomphosis and fifteen sutures.

The gomphosis only is where the teeth are fixed in their sockets, and the schindylesis is only where the edges of the vomer are joined to other bones.

The first is the *anterior nasal*, which is streight, and placed longitudinally in the middle fore-part of the nose.

The second and third are the *lateral nasal*, which are at each side of the nose, and almost parallel to the first suture.

Each of the two lacrymal is almost semicircular, and is placed round the lacrymal groove.

The sixth and seventh are the *internal orbitar:* each of which is extended obliquely from the middle of the lower side of an orbit to the edge of its base.

The two external orbitars are continued, each from the end of the internal orbitar, to the under and fore-part of the cheek.

The tenth is the *mystachial*, which reaches only from the lower part of the septum narium to between the two middle dentes incisores.

The *longitudinal palate* suture stretches from the middle of the foremost teeth through the middle of all the palate.

The *transverse palate* one runs across the palate, nearer the back than the fore-part of it.

Each of the two *palato-maxillary* is at the back-part of the side of each nostril.

The fifteenth is the *spinous*, which is in the middle of the lower part of the nostrils. This may perhaps be rather thought a double schindylesis.

These sutures of the face have not such conspicuous indentations as those of the skull have.

Ossa Nasi, so named from their situation at the root of the nose, are each of an irregular oblong square figure, being broadest at their lower end, narrowest a little higher than their middle; and becoming somewhat larger at the top, where they are ragged and thickest, and have a curvature forwards, that their connection with the frontal bone might be stronger.——These bones are convex externally, and thereby better resist any violence from without; and they are concave internally, for enlarging the cavity of the nose.

The lower edge of these bones is unequal, and is stretched outwards and backwards, to join the cartilages of the nostrils.—Their anterior side is thick, especially above, and unequal, that their conjunction to each other might be stronger; and a small rising may be remarked on their inner edge, where they are sustained by the septum narium.——Their posterior side, at its upper half, has externally a depression, where it is overlopped some way by the maxillary bones, while its lower half covers these bones: By which contrivance, they do not yield easily to pressure applied to their fore-part or sides.

A small hole is frequently to be observed on their external surface, into which two, three, or four holes, which appear internally, terminate for the transmission of small veins; sometimes the holes go no further than the cancelli of the bones.

The nasal bones are firm and solid, with very few cells or cancelli in them.

They are joined above to the frontal bone, by the middle of the transverse suture;—behind, to the maxillary bones, by the lateral nasal sutures;—below, to the cartilages of the nose;—before to one another, by the anterior nasal suture;—internally, to the septum narium.

These bones serve to cover and defend the root of the nose.

Ossa Unguis, or Lacrymalia, are so named, because their figure and magnitude are something near to those of a nail of one's fingure, and because the tears pass upon them into the nose.

Their external surface is composed of two smooth concavities and a middle ridge.——The depression behind forms a small share of the orbit for the eye-ball to move on, and the one before is a deep perpendicular canal, or fossa, larger above than below, containing part of the lacrymal sac and duct. This is the part that ought to be pierced in the great operation for the fistula lacrymalis. —This fossa of the bone is cribriform, or has a great number of small holes through it, that the filaments from the membrane which lines it, insinuating themselves into these holes, might prevent a separation of the membrane, and secure the bone in its natural situation.——The ridge between these two cavities of the os unguis, is the proper boundary of the orbit at its internal canthus; and beyond which surgeons should not proceed backwards in performing operations here.——The internal or posterior surface of this bone consists of a furrow in the middle of two convexities.

The substance of the os unguis is as thin as paper, and very brittle; which is the reason that those bones are often wanting in skeletons, and need little force to pierce them in living subjects.

Each of these bones is joined, above, to the frontal bone, by part of the transverse suture;—behind, to the os planum of the ethmoid bone, by the same suture;—before, and below, to the maxillary bone, by the lacrymal suture;—internally, the offa unguis cover some of the sinus ethmoidales.

These unguiform bones compose the anterior internal parts of the orbits, lodge a share of the lacrymal sac and duct, and cover the eithmoid cells.——Their situation and tender substance make a rash operator in danger of destroying a considerable share of the organ of smelling, when he is performing the operation of the fistula lacrymalis.

Ossa Malarum are the prominent square bones which form the cheek on each side.——Before, their surface

face is convex and ſmooth; backward, it is unequal and concave, for lodging part of the crotaphyte muſcles.

The four angles of each of theſe bones have been reckoned proceſſes by ſome.——The one at the external canthus of the orbit, called the *ſuperior orbitar* proceſs, is the longeſt and thickeſt.——The ſecond terminates near the middle of the lower edge of the orbit in a ſharp point, and is named the *inferior orbitar* proceſs.——The third, placed near the lower part of the cheek, and thence called *maxillary*, is the ſhorteſt, and neareſt to a right angle.——The fourth, which is called *zygomatic*, becauſe it is extended backwards to the zygoma of the temporal bone, ends in a point, and has one ſide ſtreight, and the other ſlopping.—Between the two orbitar angles there is a concave arch, which makes about a third of the external circumference of the orbit, from which a fifth proceſs is extended backwards within the orbit, to form near one third of that cavity; and hence it may be called the *internal orbitar* proceſs.—From the lower edge of each of the oſſa malarum, which is between the maxillary and zygomatic proceſſes, the *maſſeter* muſcle takes its origin; and from the exterior part of the zygomatic proceſs, the *muſculus diſtortor oris* riſes; in both which places the ſurface of the bone is rough.

On the external ſurface of each cheek bone, one or more ſmall holes are commonly found, for the tranſmiſſion of ſmall nerves or blood-veſſels from, and ſometimes into the orbit.——On the internal ſurface are the holes for the paſſage of the nutritious veſſels of theſe bones.——A notch on the outſide of the internal orbitar proceſs of each of theſe bones aſſiſts to form the great ſlit common to this bone and to the ſphenoid, maxillary, and palate-bones.

The ſubſtance of theſe bones is, in proportion to their bulk, thick, hard, and ſolid, with ſome cancelli.

Each of the oſſa malarum is joined, by its ſuperior and internal orbitar proceſſes, to the os frontis, and to the orbitar proceſs of the ſphenoid bone, by the tranſverſe ſuture.——By the edge between the internal and inferior orbitar proceſſes, to the maxillary bone, by the internal orbitar ſuture.—By the ſide between the maxillary and inferior orbitar proceſs, again to the maxillary bone, by the external orbitar ſuture.—By the zygomatic proceſs, to the os temporum, by the zygomatic ſuture.

Ossa Maxillaria Superiora, are the largeſt bones, and conſtitute the far greater part of the upper jaw.

The proceſſes of each os maxillare may be reckoned ſeven.—The firſt is the long naſal one at its upper and fore-part, which is broad below, and turns ſmaller, as it riſes upwards, to make the ſide of the noſe.——At the root of this, a tranſverſe ridge may be obſerved within the noſtrils, which ſupports the fore-part of the upper edge of the os ſpongioſum inferius.—The ſecond is produced backwards and outwards, from the root of the naſal proceſs, to form the lower ſide of the orbit; and therefore may be called *orbitar*.—The edge of this orbitar proceſs, and the ridge of the naſal one, which is continued from it, make a conſiderable portion of the external circumference of the orbit.—From the proper orbitar proceſs, a very rough triangular ſurface is extended downwards and outwards, to be connected to the cheek-bone; and therefore may be called the *malar* proceſs, from the loweſt protuberant part of which ſome ſhare of the maſſeter muſcle takes its riſe.——Behind the orbitar proceſs, a large tuberoſity or bulge of the bone appears, which is eſteemed the fourth proceſs.——On the internal part of this we often meet with a ridge, almoſt of the ſame height with that in the naſal proceſs, which runs tranſverſely, and is covered by a ſimilar ridge of the palate-bone, on which the back-part of the upper edge of the os ſpongioſum inferius reſts.——The convex back-part of this tuberoſity is rough for the origin of part of the external pterygoid muſcle, and more internally is ſcabrous, where the palate and ſphenoid bones are joined to it.——That ſpongy protuberance at the lower circumference of this bone, where the ſockets for the teeth are formed, is reckoned the fifth.—The ſixth is the horizontal plate, which forms the greater part of the baſe of the noſtrils, and roof of the mouth; its upper ſurface, which belongs to the noſtrils, is very ſmooth, but the other below is arched and rough, for the ſtronger adheſion of the membrane of the mouth, which is ſtretched upon it, and in chewing, ſpeaking, *&c.* might otherwiſe be liable to be ſeparated.—The ſeventh riſes like a ſpine from the inner edge of the laſt, and forms a ſmall part of the partition of the noſtrils.

The depreſſions in each maxillary bone are, 1. A ſinuoſity behind the orbitar proceſs, made by the temporal muſcle. 2. A pit immediately before the ſame proceſs, where the origin of the muſculus elevator labiorum communis, and elevator labii ſuperioris, with a branch of the fifth pair of nerves, are lodged ſecurely. 3. The hollow arch of the palate. 4. The ſemicircular great notch, or entry to the lower part of the noſtrils, betwixt the root of the naſal proceſs and ſpine of the palate-plate. 5. Sockets for the teeth: The number of theſe ſockets is uncertain. 6. The lacrymal foſſa in the naſal proceſs, which aſſiſts the os unguis to form a paſſage for the lacrymal duct. Immediately on the outſide of this, there is a ſmall depreſſion, from which the inferior or leſſer oblique muſcle of the eye has its origin. 7. The canal on the upper part of the great tuberoſity within the orbit, which is almoſt a complete hole; in this a branch of the ſuperior maxillary nerve paſſes.—Beſides theſe, the ſuperior ſurface of the great bulge is concave, to receive the under part of the eye.—Immediately above the tranſverſe ridge in the naſal proceſs, a ſmall hollow is formed by the os ſpongioſum.

The holes of this bone are two proper and two common, which are always to be found, beſides ſeveral others, whoſe magnitude, number, *&c.* are uncertain.—The firſt of the proper is the *external orbitar*, immediately below the orbit, by which the infra-orbitar branch of the ſecond branch of the fifth pair of nerves, and a ſmall artery, come out, after having paſſed in the canal, at the bottom of the orbit, deſcribed Numb. 7. of the depreſſions.—The ſecond is the *foramen inciſivum*, juſt behind the fore-teeth, which, at its under part, is one irregular hole common to both the maxillary bones when they

they are joined; but, as it aſcends, ſoon divides into two, three, or ſometimes more holes; ſome of which open into each noſtril. Through them ſmall arteries and veins, and a twig of the ſecond branch of the fifth pair of nerves paſs, and make a communication between, or join the lining coats of the noſe and mouth.

The firſt common hole is that which appears at the inner ſide of the back-part of the tuberoſity and of the ſockets of the teeth, and is formed by a foſſa in this bone, and a correſponding one in the os palati: through it a nerve, which is a branch of the ſecond branch of the fifth pair, runs to the palate.——The other common hole is the great ſlit in the outſide of the orbit deſcribed already, as the ſecond common hole of the ſphenoid bone.

All the body of the maxillary bone is hollow, and leaves a large ſinus akin to the frontal and ſphenoid, which is commonly, but unjuſtly, called *antrum Highmorianum.*—At the bottom of this cavity, we may often obſerve ſome protuberances, in which the ſmall points of the roots of the teeth are contained.—This cavern and the ſockets of the teeth are often divided by the interpoſition only of a very thin bony plate, which is liable to be eroded by acrid matter collected in the antrum, or to be broke in drawing a tooth. The ſymptoms of a collection of a matter here naturally lead us to the practice of pulling out the teeth, and piercing through this plate into the antrum, to procure an evacuation of the collected matter.

The maxillary ſinuſes have the ſame uſes as the frontal and ſphenoidal; and the ſituation of the ſinuſes is ſuch, that the liquor drilling from them, from the cells of the ethmoid and palate-bones, and from the lacrymal ducts, may always moiſten all the parts of the membrane of the nares in the different ſituations which the head is in.

The ſubſtance of the oſſa maxillaria is compact and firm, except at the inferior proceſſes, in which the teeth are lodged, where it is very ſpongy.

The maxillary bones are joined above by the upper ends of their naſal proceſſes to the os frontis, by the tranſverſe ſuture;—at the ſides of theſe proceſſes, to the oſſa unguis, by the lacrymal ſutures;—to the naſal bones, by the lateral naſal ſutures;—by their orbitar proceſſes, to the cheek-bones, by the external orbitar ſutures;—by the internal ſides of the internal orbitar proceſſes, to the oſſa plana, by part of the ethmoidal ſuture;—by the back-part of the tuberoſities, to the palate bones, by the ſuturæ palato-maxillares;—by the poſterior edges of their palatine lamellæ, to the oſſa palati, by the tranſverſe palate-ſuture;—by their naſal ſpines, to the vomer, by the ſpinous ſuture;—by their ſockets, to the teeth by gomphoſis;—by the internal edge of the palate-plate, to one another, by the longitudinal palate-ſuture; on the upper and fore-part of which a furrow is left for receiving the cartilage which forms the partition of the noſtrils; — between the fore-part of the noſtrils and mouth, to each other, by the myſtachial ſuture; — ſometimes they are connected to the oſſa ſpongioſa inferiora, by a plain concretion or union of ſubſtance.

Theſe bones form the greater part of the noſe and of the roof of the mouth, and a conſiderable ſhare of the orbit. They contain ſixteen teeth, give riſe to muſcles, tranſmiſſion to nerves, *&c.* as mentioned in the deſcription of their ſeveral parts.

Ossa Palati are commonly deſcribed as two ſmall ſquare bones, at the back-part of the palate or roof of the mouth, though they are of much greater extent, being continued up the back-part of the noſtrils to the orbit. Each palate-bone may therefore be divided into four parts, the palate ſquare bone, the pterygoid proceſs, naſal lamella, and orbitar proceſs.

The ſquare bone is unequally concave, for enlarging both the mouth and cavity of the noſe. The upper part of its internal edge riſes in a ſpine, after the ſame manner as the palate-plate of the maxillary bone does, to be joined with the vomer.——Its anterior edge is unequally ragged, for its firmer connection with the palate-proceſs of the os maxillare.—The internal edge is thicker than the reſt, and of an equal ſurface, for its conjunction with its fellow of the other ſide.——Behind, this bone is ſomewhat in form of a creſcent, and thick, for the firm connection of the velum pendulum palati; the internal point being produced backwards, to afford origin to the palato-ſtaphylinus, or azygos-muſcle.——This ſquare bone is well diſtinguiſhed from the pterygoid proceſs by a perpendicular foſſa, which, applied to ſuch another in the maxillary bone, forms a paſſage for the palatine branch of the fifth pair of nerves; and by another ſmall hole behind this, through which a twig of the ſame nerve paſſes.

The pterygoid proceſs is ſomewhat triangular, having a broad baſe, and ending ſmaller above. The back-part of this proceſs has three foſſæ formed in it; the two lateral receive the ends of the two plates of the ſphenoid bone, that are commonly compared to a bat's wing; the middle foſſa makes up a part of what is commonly called the *foſſa pterygoidea*; the fore-ſide of this palatine pterygoid proceſs is an irregular concave, where it receives the back-part of the great tuberoſity of the maxillary bone.——Frequently ſeveral ſmall holes may be obſerved in this triangular proceſs, particularly one near the middle of its baſe, which, a little above, communicates with the common and proper holes of this bone already taken notice of.

The naſal lamella of this bone is extremely thin and brittle, and riſes upwards from the upper ſide of the external edge of the ſquare bone, and from the narrow extremity of the pterygoid proceſs; where it is ſo weak, and at the ſame time ſo firmly fixed to the maxillary bone, as to be very liable to be broken in ſeparating the bones.——From the part where the plate riſes, it runs up broad on the inſide of the tuberoſity of the maxillary bone, to form a conſiderable ſhare of the ſides of the maxillary ſinus, and to cloſe up the ſpace between the ſphenoid and the great bulge of the maxillary bone, where there would otherwiſe be a large ſlit opening into the noſtrils. From the middle internal ſide of this thin plate, a croſs ridge, placed on ſuch another of the maxillary bone, is extended; on it the back-part of the os ſpongioſum

ſpongioſum inferius reſts.——Along the outſide of this plate, the perpendicular foſſa made by the palate-nerve is obſervable.

At the upper part of this naſal plate, the palate-bone divides into two proceſſes, which were already named *orbitar*;—between which and the body of the ſphenoid bone, that hole is formed, which was mentioned as the laſt of the holes common to the ſphenoid bone.——Sometimes this hole is wholly formed in the os palati, by a croſs plate going from the one orbitar proceſs to the other. A nerve, artery, and vein belonging to the noſtrils, paſs here.—The anterior of the two orbitar proceſſes is the largeſt, and has its fore-part contiguous to the back-part of the maxillary ſinus, and its upper ſurface appears in the bottom of the orbit, behind the back-part of the os maxillare and planum.—It has cells behind, reſembling thoſe of the ethmoid bone, to which it is contiguous; it is placed on the aperture of the ſinus ſphenoidalis, ſo as to leave only a round hole at its upper fore-part.—The other part of the orbitar proceſs is extended along the internal ſide of the upper back-part of the maxillary tuberoſity, to the baſe of the ſphenoid bone, between the root of the proceſſus azygos and the pterygoid proceſs.

The palate-bones are joined to the maxillary, by the fore-edge of the palate ſquare-bone, by the tranſverſe palate-ſuture:—By their thin naſal plates, and part of their orbitar proceſſes, to the ſame bones, by the palato-maxillares ſutures:—By their pterygoid proceſſes, and back-part of the naſal plates, to the alæ veſpertilionum, by the ſphenoid ſuture:—By the tranſverſe ridges of the naſal plates, to the oſſa ſpongioſa inferiora, by contact; hence frequently there is an intimate union of the ſubſtance of theſe bones in old ſkulls:——By the orbitar proceſſes, to the oſſa plana and cellulæ ethmoideæ, by the ethmoid ſuture:——To the body of the ſphenoid bone, by the ſphenoid ſuture:——By the internal edge of the ſquare-bones, to each other, by the longitudinal palate-ſuture; and by their naſal ſpines, to the vomer, by the ſpinous ſuture.

The palate-bones form part of the palate, noſtrils, orbits, and foſſæ pterygoideæ, and they cover part of the ſinus maxillares, ſphenoidales, and ethmoidei.

Ossa Turbinata, or *ſpongioſa inferiora*, reſemble the ſuperior oſſa ſpongioſa in ſhape and ſubſtance, but have their anterior and upper edges contiguous to the tranſverſe ridges of the naſal proceſſes of the maxillary and palate-bones.——From their upper ſtreight edge, two ſmall proceſſes ſtand out: the poſterior, which is the broadeſt, deſcends to cover ſome of the antrum Highmorianum; the anterior riſes up to join the os unguis, and to make part of the lacrymal duct.

Below the ſpongy bones already mentioned, there are ſometimes two others, one in each noſtril, which ſeem to be a production of the ſides of the maxillary ſinus turned downwards. When this third ſort of ſpongy bones is found, the middle one of the three in each noſtril is the largeſt, and the loweſt is the ſmalleſt.——Beſides all theſe, there are often ſeveral other ſmall bones ſtanding out into the noſtrils, that, from their ſhape, might alſo deſerve the name of *turbinata*, but are uncertain in their bulk, ſituation, and number.

They are joined to the oſſa maxillaria, palati, and unguis, eſpecially in old ſubjects.

Their uſe is, to ſtraiten the noſtrils, to afford a large ſurface for extending the organ of ſmelling, to cover part of the antra maxillaria, and to aſſiſt in forming the under part of the lacrymal ducts, the orifices of which into the noſe are concealed by theſe bones.

Vomer, or bone reſembling a ploughſhare, is the thirteenth of the upper jaw, without a fellow, forming the lower and back-parts of the partition of the noſe.

The figure of this bone is an irregular rhomboid.—Its ſides are flat and ſmooth.——Its poſterior edge appears in an oblique direction at the back-part of the noſtrils.——The upper one is firmly united to the baſe of the ſphenoid bone, and to the naſal plate of the ethmoid; and, when it can be got ſeparated, is hollow, for receiving the proceſſus azygos of the ſphenoid.——The anterior edge has a long furrow in it, where the middle cartilage of the noſe enters.——The lower edge is firmly united to the naſal ſpines of the maxillary and palate-bones.——Theſe edges of this bone are much thicker than its middle, which is as thin as the fineſt paper.

Its ſituation is not always perpendicular, but often inclined and bended to one ſide, as well as the naſal plate of the ethmoid-bone.

The vomer is convex at its upper part, and then is ſtreight as it is extended downwards and forwards, where it is compoſed of two plates; the edges of which have a great number of ſmall proceſſes, diſpoſed ſomewhat like the teeth of a ſaw, but more irregularly, and ſeveral of them are reflected back. Between theſe plates, a deep foſſa is left, which, ſo far as the top of the curvature, is wide, and has ſtrong ſides, for receiving the proceſſus azygos of the ſphenoid-bone. Beyond the arch forwards, the foſſa is narrower and ſhallower gradually to the point of the bone, receiving for ſome way the naſal lamella ethmoidea, which is ſo cloſely united to the vomer, by the little proceſſes piercing into its ſubſtance, as to prevent any ſeparation. The middle cartilage of the noſe fills up what remains of the foſſa at its fore-part.——The poſterior edge of the vomer, which appears above the back-part of the palate-bones, is broader above; but as it deſcends forwards, becomes thinner, though it is ſtill ſolid and firm.——The lower edge of this bone, which reſts on the naſal ſpine of the palate and maxillary bones, has a little furrow on each ſide, of a ſmall middle ridge, anſwering to the ſpines of the bones of different ſides, and the interſtice between them. This edge and the upper one meet in the pointed fore-end of this bone.

The body of the vomer has a ſmooth ſurface, and ſolid, but thin ſubſtance; and towards its ſides, where it is thickeſt, ſome cancelli may be obſerved, when the bone is broken.

It is joined above to the ſphenoid and ethmoid bones, and to the middle cartilage of the noſe, by ſchindyleſis;—below, to the maxillary and palate-bones, by the ſpinous ſuture.

The

The vomer divides the noſtrils, enlarges the organ of ſmelling, by allowing place for expanding the membrane of the noſe on its ſides, and ſuſtains the palate-plates of the maxillary and palate-bones.

Maxilla Inferior, the lower jaw, conſiſts only of one moveable bone, and ſixteen teeth incaſed into it.

This bone, which is ſomewhat of the figure of the Greek letter *υ*, is ſituated at the lower part of the face, ſo as its convex middle part is forwards, and its legs are ſtretched back. It is commonly divided into the chin, ſides, and proceſſes.—The chin is the middle fore-part, the extent of which to each ſide is marked on the external ſurface by the holes obſervable there, and internally, by the beginning of an oblique ridge.—Beyond theſe, the ſides appear, and are continued till the bone, by bending upwards, begins to form the proceſſes.

On the fore-part of the chin, a tranſverſe ridge appears in the middle, on each ſide of which the muſculi quadrati, or depreſſores labii inferioris, and the levatores labii inferioris, depreſs the bone: And below theſe prints, a ſmall riſing may be obſerved, where the depreſſores commence.—On the back-part of the chin, ſometimes three, always two, ſmall protuberances appear in the middle. To the uppermoſt, when it is ſeen, the frænum of the tongue is connected. From the middle one, the muſculi geniogloſſi riſe; and from the loweſt, the geniohyoidei have their origin.

At the lower and fore-part of the external ſurface of each ſide of the lower jaw, a ſmall eminence may be obſerved, where the depreſſor labiorum communis riſes. Near the upper edge of the ſide a ridge runs length-ways, to which the under part of the muſculus buccinator is connected.——Internally, towards the upper edge of each ſide, another ridge appears, from which the mylohyoidei have their origin, and to which the internal membrane of the gums adheres.

In the upper edge of both chin and ſides are a great many deep pits or ſockets, for receiving the roots of the teeth. The number and magnitude of theſe ſockets are various, becauſe of the different number, as well of the teeth themſelves, as of their roots, in different people. Theſe ſockets in this lower jaw, as well as in the upper one, are leſs deep as old age comes on; when freed from the teeth by any means, they are ſome time after filled up with an oſſeous net-work, which at laſt becomes entirely ſolid, and as ſmooth as any other part of the bone; ſo that in a great many old jaws one cannot obſerve a veſtige of the ſockets: But then the jaw becomes leſs, and much narrower.—Hence we may know why the chin and noſe of edentulous people are much nearer than before the teeth were loſt; while their lips either fall in towards the mouth, or ſtand prominent forwards.——When new teeth are protruded, new ſockets are formed.——The lower edge of the chin and ſides is ſmooth and equal, and is commonly called the *baſe* of the lower jaw.——The ends of the baſe, where the jaw turns upwards, are called its angles; the external ſurface of each of which has ſeveral inequalities upon it, where the maſſeter muſcle is inſerted; as the internal ſurface alſo has, where the pterygoideus internus is inſerted, and a ligament, extended from the ſtyloid proceſs of the temporal bone, is fixed.

The proceſſes are two on each ſide.——The anterior ſharp thin coronoid ones have the crotaphyte muſcles inſerted into them.——The poſterior proceſſes, or condyles, terminate in an oblong ſmooth head, ſupported by a cervix. The heads, whoſe greateſt length is tranſverſe, and whoſe convexity is turned forwards, are tipped with a cartilage, as the articulated parts of all other moved bones are.—The fore-part of the root and neck of theſe condyloid proceſſes are a little hollow and rough, where the external pterygoid muſcles are inſerted.

The holes of the lower jaw are two on each ſide; one at the root of the proceſſes internally, where a large branch of the third branch of the fifth pair of nerves enters with an artery, and a vein returns. A ſmall ſharp proceſs frequently jutts out backwards from the edge at the fore-part of this hole, to which a ligament, extended from the temporal bone, is fixed, which ſaves the nerve and veſſels from being too much preſſed by the pterygoid muſcles.——From the lower ſide of this hole, either a ſmall ſuperficial canal or a furrow deſcends, where a branch of the nerve is lodged, in its way to the mylohyoideus muſcle and ſublingual gland.——The other hole is external, at the confines of the chin, where branches of the nerve and veſſels come out.——The canal betwixt theſe two holes is formed in the middle of the ſubſtance of the bone, and is pierced by a great number of ſmall holes by which the nerves and blood-veſſels of the cancelli and teeth paſs.

The lower jaw generally receives the roots of ſixteen teeth into its ſockets, by gomphoſis; and its condyloid proceſſes, covered with cartilage, are articulated with the temporal bones.

The Teeth are the hard white bodies placed in the ſockets of both jaws. Their number is generally ſixteen above, and as many below; though ſome people have more, others have fewer.

The broad thick part of each tooth which appears without the ſocket, is the baſe, or body.——The ſmaller proceſſes ſunk into the maxillæ, are the roots or fangs, which become gradually ſmaller towards the end fartheſt from the baſe, or are nearly conical, by which the ſurface of their ſides divides the preſſure made on the baſes, to prevent the ſoft parts, which are at the ſmall points of the ſockets, to be hurt by ſuch preſſure.

Without the gums the teeth are covered with no membrane, and they are ſaid to have no proper perioſteum within the ſockets; but that is ſupplied by the reflected membrane of the gums; which, after a good injection, may be evidently ſeen in a young ſubject, with the veſſels from it penetrating into the ſubſtance of the teeth; and it may be diſcovered in any tooth recently pulled, by macerating it in water. The adheſion of this membrane to theſe roots is ſtrengthened by the ſmall furrows obſervable on them.

Each tooth is compoſed of its cortex, or enamel, and an internal bony ſubſtance. The cortex has no cavity or place for marrow; and is ſo ſolid and hard, that ſaws or files can with difficulty make impreſſion on it. It is

thickeſt

thickeſt upon the baſe, and gradually, as the roots turn ſmaller, becomes thinner.——The fibres of this enamel are all perpendicular to the internal ſubſtance, and are ſtreight on the baſe, but at the ſides are arched with a convex part towards the roots; which makes the teeth reſiſt the compreſſion of any hard body between the jaws, with leſs danger of breaking theſe fibres, than if they had been ſituated tranſverſely. The ſpongy ſockets in which the teeth are placed likewiſe ſerve better to prevent ſuch an injury, than a more ſolid baſe would have done.

The bony part of the teeth has its fibres running ſtreight, according to the length of the teeth. When it is expoſed to the air, by the breaking or falling off of the hard cortex, it ſoon corrupts. And thence carious teeth are often all hollow within, when a very ſmall hole appears only externally.

The teeth have canals formed in their middle, wherein their nerves and blood-veſſels are lodged; which they certainly need, being conſtantly waſted by the attrition they are ſubjected to in manducation, and for their further growth, not only after they firſt appear, but even in adults; as is evident when a tooth is taken out: For then the oppoſite one becomes longer, and thoſe on each ſide of the empty ſocket turn broader; ſo that when the jaws are brought together, it is ſcarce obſervable where the tooth is wanting.

The veſſels are eaſily traced ſo long as they are in the large canal, but can ſcarce be obſerved in their diſtribution from that to the ſubſtance of the teeth of adults. ——This plentiful ſupply of veſſels muſt expoſe the teeth to the ſame diſorders that attack other vaſcular parts.

Every root of each tooth has ſuch a diſtinct canal, with veſſels and nerves in it. Theſe canals in the teeth with more than one root, come nearer each other, as they approach the baſe of the tooth: and at laſt are only ſeparated by very thin plates, which being generally incomplete, allow a communication of all the canals; and frequently one common cavity only appears within the baſe, in which a pulpy ſubſtance, compoſed of nerves and veſſels, is lodged.

The entry of the canals for theſe veſſels is a ſmall hole placed a little to a ſide of the extreme point of each root; ſometimes, eſpecially in old people, this hole is entirely cloſed up, and conſequently the nerves and blood-veſſels are deſtroyed.

The teeth are ſeen for a conſiderable time in form of mucus contained in a membrane; afterwards a thin cortical plate, and ſome few oſſeous layers appear within the membrane, with a large cavity filled with mucus in the middle; and gradually this exterior ſhell turns thicker, the cavity decreaſes, the quantity of mucus is leſſened, and this induration proceeds till all the body is formed; from which the roots are afterwards produced.

In young ſubjects, different ſtamina, or rudiments of teeth, are to be obſerved. Thoſe next the gums hinder ordinarily the deeper-ſeated ones from making their way out, while theſe prevent the former from ſending out roots, or from entering deep into the bony ſockets of the jaws; by which they come to be leſs fixed.

Children are ſeldom born with teeth; but at two years of age they have twenty; and their number does not increaſe till they are about ſeven years old, when the teeth that firſt made their way through the gums are thruſt out by others that have been formed deeper in the jaw, and ſome more of the teeth begin to diſcover themſelves farther back in the mouth. About fourteen years of age, ſome more of the firſt crop are ſhed, and the number is increaſed.——This ſhedding of the teeth is of good uſe; for if the firſt had remained, they would have ſtood at a great diſtance one from another; becauſe the teeth are too hard in their outer cruſt, to increaſe ſo faſt as the jaws do. Whereas both the ſecond layer, and the teeth that come out late, meeting, while they are ſoft, with a conſiderable reſiſtance to their growth in length, from thoſe ſituated upon them, neceſſarily come out broad, and fit to make that cloſe guard to the mouth, which they now form.

The teeth are joined to the ſockets by gomphoſis, and the gums contribute to fix them there; as is evident by the teeth falling out when the gums are any way deſtroyed, or made too ſpongy; as in the ſcurvy or ſalivations: Whence ſome claſs this articulation with the ſyſſarcoſis.

The uſes of the teeth are to maſticate our aliment, and to aſſiſt us in the pronunciation of ſeveral letters.

Though the teeth ſo far agree in their ſtructure, yet, becauſe of ſome things wherein they differ, they are generally divided into three claſſes, *viz. inciſores, canini*, and *molares*.

The inciſores, are the four fore-teeth in each jaw, receiving their name from their office of cutting our aliment; for which they are excellently adapted, being each formed into a ſharp-cutting edge at their baſe, by their fore-ſide turning inwards there, while they are ſlopped down and hollowed behind; ſo that they have the form of wedges; and therefore their power of acting muſt be conſiderably increaſed.

The inciſores of the upper jaw, eſpecially the two middle ones, are broader and longer generally than thoſe of the under jaw.

Canini, from the reſemblance to dogs tuſks, are one on each ſide of the inciſores in each jaw.——The two in the upper jaw are called *eye-teeth*, from the communication of nerves which is ſaid to be betwixt them and the eyes.——The two in the lower jaw are named *angular*, or *wike-teeth*, becauſe they ſupport the angles of the mouth.

The canini are broader, longer, and ſtronger, than the inciſores.——Their baſes are formed into a ſharp edge, as the inciſores are; only that the edge riſes into a point in the middle.——Each of them has generally but one long root, though ſometimes they have two. The roots are crooked towards the end.——The canini of the upper jaw are larger, longer, and with more crooked roots, than thoſe of the under jaw.

The dentes molares, or grinders, which have got their name becauſe they grind our food, are generally five in each ſide of each jaw; in all twenty. Their baſes are broader, more ſcabrous, and with a thinner cortical ſubſtance, than the other teeth. They have alſo more roots,

roots, and as theſe roots generally divaricate from each other, the partitions of the ſockets between them bear a large ſhare of the great preſſure they ſuffer, and hinder it to act on their points.

The numerous roots of the dentes molares prevent their looſening by the lateral preſſure they ſuffer in grinding; and as the ſockets in the upper jaw are more ſpongy, and the teeth are more liable, by their ſituation, to fall out, the grinders there have more numerous and more ſeparated roots than in the lower jaw.

According to the diviſion made of the ſkeleton, we ſhould now proceed to the deſcription of the trunk of the body. But muſt firſt conſider a bone, which cannot well be ſaid to belong to either the head or the trunk; nor is it immediately joined to any other, and therefore is very ſeldom preſerved with ſkeletons.

The Os Hyoides, which is ſituated horizontally between the root of the tongue and the larynx. It is properly enough named *hyoides*, from the reſemblance it bears to the Greek letter υ, and may, for a clearer demonſtration of its ſtructure, be diſtinguiſhed into its body, cornua, and appendices.

The body is the middle broad part, convex before, and hollow behind.——The convex fore-part is divided into two, by a ridge, into the middle of which the mylo-hyoidei, and into the ſides the ſtylo-hyoidei, muſcles are inſerted.——Above the ridge, the bone is horizontal, but pitted in the middle by the inſertion of the two genio-hyoidei muſcles, and a little hollowed more laterally by the baſiogloſſi.——Below the ridge, it is convex, but a little flatted in the middle by the ſterno-hyoidei, and pitted more externally by the coraco-hyoidei——The concavity behind faces backwards and downwards to receive the thyroid cartilage, when the larynx and the os hyoides are pulled towards each other by the action of the ſterno-hyoidei and hyothyroidei muſcles; and to its upper edge, the ligamentous membranes of the epiglotis, tongue, and thyroid cartilage, are fixed.

The cornua of the os hyoides are ſtretched backwards from each ſide of its body, where often a ſmall furrow points out the former ſeparation.——Theſe cornua are not always ſtreight, nor of equal length; their two plain ſurfaces ſtand obliquely ſloping from above, outwards and downwards.——Into the external, the cerato gloſſus is inſerted above, and the thyro-hyoideus muſcle below; and to the one behind, the ligamentous membrane of the tongue and larynx adheres. Each of the cornua becomes gradually ſmaller, as it is extended from the baſe; but ends in a round tubercle, from which a moveable cartilage ſtands out, which is connected to the upper proceſs of the cartilago thyroidea.

Where the body of the os hyoides joins on each ſide with its cornua, a ſmall ſtyliform proceſs, called *appendix*, riſes upwards and backwards, into which the muſculi ſtylo-hyoidei alteri, and part of the hyo-gloſſi muſcles are fixed.

The ſubſtance of the os hyoides is cellular, but covered with a firm external plate, which is of ſufficient ſtrength to bear the actions of ſo many muſcles as are inſerted into it.

It is not articulated with any bone of the body, except by means of the muſcles and ligaments mentioned.

The uſe of the os hyoides, is to ſerve as a ſolid lever for the muſcles to act with, in raiſing or depreſſing the tongue and larynx, or in enlarging and diminiſhing the capacity of the fauces.

OF THE TRUNK.

The Trunk conſiſts of the *ſpine*, *pelvis*, and *thorax*.

The Spine is the long pile of bones extended from the condyles of the occiput to the end of the rump. It ſomewhat reſembles two unequal pyramids joined in a common baſe. It is not, however, ſtreight; for its upper part being drawn backwards by ſtrong muſcles, it gradually advances forwards, to ſupport the œſophagus, veſſels of the head, *&c.* Then it turns backwards, to make place enough for the heart and lungs. It is next bended forwards, to ſupport the viſcera of the abdomen. It afterwards turns backwards, for the enlargement of the pelvis. And, laſtly, it is reflected forwards, for ſuſtaining the loweſt great gut.

The ſpine is commonly divided into true and falſe vertebræ; the former conſtituting the long upper pyramid, which has its baſe baſe below, while the falſe vertebræ make the ſhorter lower pyramid, whoſe baſe is above.

The True Vertebrae are the twenty-four upper bones of the ſpine, on which the ſeveral motions of the trunk of our bodies are performed; from which uſe they have juſtly got their name.

Each of theſe vertebræ is compoſed of its body and proceſſes.

The body is the thick ſpongy fore-part, which is convex before, concave backwards, horizontal and plain in moſt of them above and below.——Numerous ſmall holes, eſpecially on the fore and back-part of their ſurface, give paſſage to their veſſels, and allow the ligaments to enter their ſubſtance.——The edges of the body of each vertebra are covered, eſpecially at the fore-part, with a ring of bone firmer and more ſolid than the ſubſtance of the body any where elſe. Theſe rings are of great uſe in preventing the ſpongy bodies from being broken in the motions of the trunk.

Between the bodies of each two adjoining vertebræ, a ſubſtance between the nature of ligament and cartilage is interpoſed; which ſeems to conſiſt of concentrical curve fibres, when it is cut horizontally; but when it is divided perpendicularly, the fibres appear oblique and decuſſating each other.——The outer part of the intervertebral ligaments is the moſt ſolid and hard; and they gradually become ſofter till they are almoſt in the form of a glairy liquor in the centre; and therefore theſe ſubſtances were not improperly called *mucous ligaments* by the ancients. The external fibrous part of each is capable of being greatly extended, and of being compreſſed into a very ſmall ſpace, whilſt the middle fluid part is incompreſſible, or nearly ſo; and the parts of this ligament between the circumference and centre approach in their properties to either, in proportion to their more ſolid or

or more fluid texture. The middle point is therefore a fulcrum or pivot, on which the motion of a ball and socket may be made, with such a gradual yielding of the substance of the ligament, in whichever direction our spines are moved, as saves the body from violent shocks, and their dangerous consequences.——This ligamento-cartilaginous substance is firmly fixed to the horizontal surfaces of the bodies of the vertebræ, to connect them, in which it is assisted by a strong membranous ligament, which lines all their concave surface, and by still a stronger ligament, that covers all their anterior convex surface.

From each side of the body of each vertebra, a bony bridge is produced backwards, and to a side; from the posterior end of which, one slanting process rises and another descends; the smooth, and what is generally the flattest side of each of these four processes, which are called the *oblique*, is covered with a smooth cartilage; and the two lower ones of each vertebra, are fitted to, and articulated with the two upper or ascending oblique processes of the vertebra below, having their articular ligaments fixed into the rough line round their edges.

From between the oblique processes of each side the vertebra is stretched out laterally into a process that is named *transverse*.

From the back-part of the roots of the two oblique, and of the transverse process of each side, a broad oblique bony plate is extended backwards, where these meet, the seventh process of the vertebræ takes its rise, and stands out backwards: This being generally sharp pointed, and narrow edged, has therefore been called *spinal* process; from which this whole chain of bones has got its name.

Besides the common ligament which lines all the internal surface of the spinal processes, as well as of the bodies, there are particular ligaments that connect the bony bridges and processes of the contiguous vertebræ together.

The substance of the processes is considerably stronger and firmer, and has a thicker external plate than the bodies of the vertebræ have.

The seven processes form a concavity at their fore-part, which, joined to the one at the back-part of the bodies, makes a great hole, and the holes of all the vertebræ form a long large conduit, for containing the spinal marrow.——In the upper and lower edge of each lateral bridge, there is a notch. These are so adapted to each other in the contiguous vertebræ, as to form a round hole in each side between each two vertebræ, through which the nerves that proceed from the spinal marrow and its blood-vessels pass.

The articulations then of these true vertebræ are plainly double; for their bodies are joined by the intervening cartilage above described, and their oblique processes being tipped with cartilages, are so connected by their ligaments, as to allow a small degree of motion to all sides.

The true vertebræ serve to give us an erect posture; to allow sufficient and secure motion to the head, neck, and trunk of the body, and to support and defend the bowels, and other soft parts.

Though the true vertebræ agree in the general structure which we have hitherto described; yet because of several specialities proper to a particular number, they are commonly divided into three classes, viz. *cervical*, *dorsal*, and *lumbar*.

The cervical are the seven uppermost vertebræ; which are distinguished from the rest by these marks.——Their bodies are smaller and more solid than any others, and flatted on the fore-part, to make way for the œsophagus; or rather this flat figure is owing to the pressure of that pipe, and to the action of the longi colli and anterior recti muscles.——They are also flat behind, where small processes rise, to which the internal ligaments are fixed. ——The upper surface of the body of each vertebra is made hollow, by a slanting thin process which is raised on each side:—The lower surface is also excavated, but in a different manner; for here the posterior edge is raised a little, and the one before is produced a considerable way.——Hence we see how the cartilages between those bones are firmly connected, and their articulations are secure.

The cartilages between these vertebræ are thick, especially at their fore-part; which is one reason why the vertebræ advance forward as they descend, and have larger motion.

The oblique processes of these bones of the neck more justly deserve that name than those of any other vertebræ. They are situated slanting; the upper ones having their smooth and almost flat surfaces facing obliquely backwards and upwards, while the inferior oblique processes have their surfaces facing obliquely forwards and downwards.

The transverse processes of these vertebræ are framed in a different manner from those of any other bones of the spine: For besides the common transverse process rising from between the oblique processes of each side, there is a second one that comes out from the side of the body of each vertebra; and these two processes, after leaving a circular hole for the passage of the cervical artery and vein, unite, and are considerably hollowed at their upper part, with rising sides, to protect the nerves that pass in the hollow; and at last each side terminates in an obtuse point, for the insertion of muscles.

The spinal processes of these cervical bones stand nearly streight backwards, are shorter than those of any other vertebræ, and are forked or double at their ends; and hence allow a more convenient insertion to muscles.

So far most of the cervical vertebræ agree; but they have some particular differences, which oblige us to consider them separately.

The first, from its use of supporting the head, has the name of *atlas*; and is also called *epistrophea*, from the motion it performs on the second.

The atlas, contrary to all the other vertebræ of the spine, has no body; but, instead of it, there is a bony arch.——In the convex fore-part of which, a small rising appears, where the musculi longi colli are inserted; and, on each side of this protuberance, a small cavity may be observed, where the recti interni minores take their rise.——The upper and lower parts of the arch are rough and unequal, where the ligaments that connect

connect this vertebra to the os occipitis, and to the second vertebra, are fixed.——The back-part of the arch is concave, smooth, and covered with a cartilage, in a recent subject, to receive the tooth-like process of the second vertebra.——In a first vertebra, from which the second has been separated, this hollow makes the passage for the spinal marrow to seem much larger than it really is: On each side of it a small rough sinuosity may be remarked, where the ligaments going to the sides of the tooth-like process of the following vertebra are fastened; and on each side, a small rough protuberance and depression is observable, where the transverse ligament, which secures the tooth-like process in the sinuosity, is fixed, and hinders that process from injuring the medulla spinalis in the flections of the head.

The atlas has as little spinal process as body; but instead thereof, there is a large bony arch, that the muscles which pass over this vertebra at that place might not be hurt in extending the head.

The superior oblique processes of this atlas are large, oblong, hollow, and more horizontal than in any other vertebra.——They rise more in their external than internal brim; by which their articulations with the condyloid of the os occipitis are firmer.——Under the external edge of each of these oblique processes, is the fossa, or deep open channel, in which the vetebral arteries make the circular turn, as they are about to enter the great foramen of the occipital bone, and where the tenth pair of nerves goes out.——The inferior oblique processes extending from within outwards and downwards, are large, concave, and circular. So that this vertebra, contrary to the other six, receives the bones with which it is articulated both above and below.

The transverse processes here are not much hollowed or forked, but are longer and larger than those of any other vertebra of the neck, for the origin and insertion of several muscles.

The hole for the spinal marrow is larger in this than in any other vertebra, not only on account of the marrow being largest here, but also to prevent its being hurt by the motions of this vertebra on the second one.——This large hole, and the long traverse processes, make this the broadest vertebra of the neck.

The condyles of the os occipitis move forwards and backwards in the superior oblique processes of this vertebra; but from the figure of the bones forming these joints, it appears, that very little motion can here be allowed to either side; and there must be still less circular motion.

The second vertebra colli is called *dentata*, from the tooth-like process on the upper part of its body.

The body of this vertebra is somewhat pyramidical, being large, and produced downwards, especially at its fore-side, to enter into a hollow of the vertebra below; while the upper part has a square process with a small point standing out from it. This it is that is imagined to resemble a tooth, and has given name to the vertebra.—The side of this process, on which the hollow of the anterior arch of the first vertebra plays, is convex, smooth, and covered with a cartilage; and it is of the same form behind, for the ligament, which is extended transversely from one rough protuberance of the first vertebra to the other, and is cartilaginous in the middle, to move on it.

The superior oblique processes of this vertebra dentata are large, circular, very nearly in an horizontal position, and slightly convex, to be adapted to the inferior oblique processes of the first vertebra.

The transverse processes of the vertebra dentata are short, very little hollowed at their upper part, and not forked at their ends; and the canals through which the cervical arteries pass, are reflected outwards about the middle substance of each process; so that the course of these vessels may be directed towards the transverse processes of the first vertebra.

The spinal proeess of this vertebra tendata is thick, strong, and short, to give sufficient origin to the musculi recti majores, and obliqui inferiores, and to prevent the contusion of these and other muscles in pulling the head back.

The third vertebra of the neck is by some called *axis*; but this name is applied to it with much less reason than to the second.——This third, and the three below, have nothing particular in their structure; but all their parts come under the general description formerly given, each of them being larger as they descend.

The seventh vertebra of the neck is near to the form of those of the back, having the upper and lower surfaces of its body less hollow than the others:—The oblique processes are more perpendicular;—neither spinal nor transverse processes are forked.—This seventh and the sixth vertebra of the neck have the hole in each of their transverse processes, more frequently divided by a small cross bridge, that goes between the cervical vein and artery, than any of the other vertebræ.

The twelve dorsal may be distinguished from the other vertebræ of the spine by the following marks.

Their bodies are of a middle size, betwixt those of the neck and loins;—they are more convex before than either of the other two sorts; and are flatted laterally by the pressure of the ribs, which are inserted into small cavities formed in their sides. This flatting on their sides, which makes the figure of these vertebræ almost an half oval, is of good use; as it affords a firm articulation to the ribs, allows the trachea arteria to divide at a small angle, and the other large vessels to run secure from the action of the vital organs.——These bodies are more concave behind than any of the other two classes.——Their upper and lower surfaces are horizontal.

The cartilages interposed between the bodies of these vertebræ are thinner than in any other of the true vertebræ; and contribute to the concavity of the spine in the thorax, by being thinnest at their fore-part.

The oblique processes are placed almost perpendicular; the upper ones slanting but a little forwards, and the lower ones slanting as much backwards.—They have not as much convexity or concavity as is worth remarking.——Between the oblique processes of opposite sides, several sharp processes stand out from the upper and lower parts of the plates which join to form the spinal process; into these sharp processes strong ligaments are fixed, for connecting the vertebræ.

The

The tranſverſe proceſſes of the dorſal vertebræ are long, thicker at their ends than in the middle, and turned obliquely backwards.

The ſpinal proceſſes are long, ſmall pointed, and ſloping downwards and backwards; from their upper and back-part a ridge riſes, which is received by a ſmall channel in the fore-part of the ſpinal proceſs immediately above, which is here connected to it by a ligament.

The conduit of the ſpinal marrow is here more circular, but, correſponding to the ſize of that cord, is ſmaller than in any of the other vertebræ, and a larger ſhare of the holes in the bony bridges, for the tranſmiſſion of the nerves, is formed in the vertebra above, than in the one below.

The connection of the dorſal vertebræ to the ribs, the thinneſs of their cartilages, the erect ſituation of the oblique proceſſes, the length, ſloping, and connection of the ſpinal proceſſes, all contribute to reſtrain theſe vertebræ from much motion, which might diſturb the actions of the heart and lungs; and, in conſequence of the little motion allowed here, the intervertebral cartilages ſooner ſhrivel, by becoming more ſolid: And therefore, the firſt remarkable curvature of the ſpine obſerved, as people advance to old age, is in the leaſt ſtretched vertebræ of the back; or old people firſt become round-ſhouldered.

The bodies of the four uppermoſt dorſal vertebræ deviate from the rule of the vertebræ, becoming larger as they deſcend; for the firſt of the four is the largeſt, and the other three below gradually become ſmaller, to allow the trachea and large veſſels to divide at ſmaller angles.

The two uppermoſt vertebræ of the back, inſtead of being very prominent forwards, are flatted by the action of the muſculi longi colli and recti majores.

The proportional ſize of the two little depreſſions in the body of each vertebra, for receiving the heads of the ribs, ſeems to vary in the following manner; the depreſſion on the upper edge of each vertebra decreaſes as far down as the fourth, and after that increaſes.

The tranſverſe proceſſes are longer in each lower vertebra to the ſeventh or eighth, with their ſmooth ſurfaces, for the tubercles of the ribs, facing gradually more downwards; but afterwards, as they deſcend, they become ſhorter, and the ſmooth ſurfaces are directed more upwards.

The ſpinous proceſſes of the vertebræ of the back become gradually longer and more ſlanting from the firſt, as far down as the eighth or ninth vertebra; from which they manifeſtly turn ſhorter and more erect.

The firſt vertebra, beſides an oblong hollow in its lower edge, that aſſiſts in forming the cavity wherein the ſecond rib is received, has the whole cavity for the head of the firſt rib formed in it.

The ſecond has the name of *axillary*, without any thing particular in its ſtructure.

The eleventh often has the whole cavity for the eleventh rib in its body, and wants the ſmooth ſurface on each tranſverſe proceſs.

The twelfth always receives the whole head of the laſt rib, and has no ſmooth ſurface on its tranſverſe proceſſes, which are very ſhort.——The ſmooth ſurfaces of its inferior oblique proceſſes face outwards as the lumbar do. ——And we may ſay in general, that the upper vertebræ of the back loſe gradually their reſemblance to thoſe of the neck, and the lower ones come nearer to the figure of the lumbar.

The loweſt order of the true vertebræ is the lumbar, which are five bones, that may be diſtinguiſhed from any others by theſe marks: 1. Their bodies, though of a circular form at their fore-part, are ſomewhat oblong from one ſide to the other; which may be occaſioned by the preſſure of the large veſſels, the aorta and cava, and of the viſcera. The epiphyſes on their edges are larger, and therefore the upper and lower ſurfaces of their bodies are more concave than in the vertebræ of the back. 2. The cartilages between theſe vertebræ are much the thickeſt of any, and render the ſpine convex within the abdomen, by their greateſt thickneſs being at their fore-part. 3. The oblique proceſſes are ſtrong and deep; thoſe in oppoſite ſides being almoſt placed in parallel planes; the ſuperior, which are concave, facing inwards, and the convex inferior ones facing outwards: and therefore each of theſe vertebræ receives the one above it, and is received by the one below; which is not ſo evident in the other two claſſes already deſcribed. 4. Their tranſverſe proceſſes are ſmall, long, and almoſt erect, for allowing large motion to each bone, and ſufficient inſertion to muſcles, and for ſupporting and defending the internal parts. 5. Betwixt the roots of the ſuperior oblique and tranſverſe proceſſes, a ſmall protuberance may be obſerved, where ſome of the muſcles that raiſe the trunk of the body are inſerted. 6. Their ſpinal proceſſes are ſtrong, ſtreight, and horizontal, with broad flat ſides, and a narrow edge above and below; this laſt being depreſſed on each ſide by muſcles. And at the root of theſe edges, we ſee rough ſurfaces for fixing the ligaments. 7. The canal for the numerous cords, called *cauda equina*, into which the ſpinal marrow divides, is rather larger in theſe bones than what contains that marrow in the vertebræ of the back. 8. The holes for the paſſage of the nerves are more equally formed out of both the contiguous vertebræ than in the other claſſes; the upper one furniſhes however the larger ſhare of each hole.

The thick cartilages between theſe lumbar vertebræ, their deep oblique proceſſes, and their erect ſpinal proceſſes, are all fit for allowing large motion; though it is not ſo great as what is performed in the neck; which appears from comparing the arches which the head deſcribes when moving on the neck, or the loins only.

The lumbar vertebræ, as they deſcend, have their oblique proceſſes at a greater diſtance from each other, and facing more backwards and forwards.

Both tranſverſe and ſpinal proceſſes of the middlemoſt vertebræ of the loins are longeſt and thickeſt; in the vertebræ above and below they are leſs: ſo that theſe proceſſes of the firſt and fifth are the leaſt, to prevent their ſtriking on the ribs or oſſa ilium, or their bruiſing the muſcles in the motions of the ſpine.

The ephiphyſes round the edges of the bodies of the lumbar vertebræ are moſt raiſed in the two loweſt, which conſequently make them appear hollower in the middle than the others are.

The body of the fifth vertebra is rather thinner than that of the fourth.——The ſpinal proceſs of this fifth is ſmaller, and the oblique proceſſes face more backwards and forwards than in any other lumbar vertebra.

The FALSE VERTEBRÆ compoſe the under pyramid of the ſpine. They are diſtinguiſhed from the bones already deſcribed juſtly enough by this epithet of *falſe*; becauſe, though each bone into which they can be divided in young people, reſembles the true vertebræ in figure, yet none of them contribute to the motion of the trunk of the body; they being intimately united to each other in adults, except at their lower part, where they are moveable; whence they are commonly divided into two bones, *os ſacrum* and *coccygis*.

OS SACRUM, is ſo called from being offered in ſacrifice by the ancients, is of an irregular triangular ſhape, broad above, narrow below, convex behind, for the advantageous origin of the muſcles that move the ſpine and thigh backwards; and concave behind, for enlarging the cavity of the pelvis.——Four tranſverſe lines of a colour different from the reſt of the bone, which are ſeen on its fore-part, are the marks of diviſion of the five different bones of which it conſiſts in young perſons.

The fore-part of the os ſacrum is ſmooth and flat, to allow a larger ſpace for the contained bowels, without any danger of hurting them.—The back-part of it is almoſt ſtreight, without ſo large a cavity as the vertebræ have.—The bridges between the bodies and proceſſes of this bone, are much thicker, and in proportion ſhorter, than in the former claſs of bones.—The ſtrength of theſe croſs-bridges is very remarkable in the three upper bones, and is well-proportioned to the incumbent weight of the trunk of the body, which theſe bridges ſuſtain in a tranſverſe, conſequently an unfavourable, ſituation, when the body is erect.

There are only two oblique proceſſes of the os ſacrum; one ſtanding out on each ſide from the upper part of the firſt bone.——Their plain erect ſurfaces face backwards, and are articulated with the inferior oblique proceſſes of the laſt vertebra of the loins, to which each of theſe proceſſes is connected by a ſtrong ligament, which riſes from a ſcabrous cavity round their roots, where mucilaginous glands are alſo lodged.—Inſtead of the other oblique proceſſes of this bone, four rough tubercles are to be ſeen on each ſide of its ſurface behind, from which the *muſculus ſacer* has its origin.

The tranſverſe proceſſes here are all grown together into one large ſtrong oblong proceſs on each ſide; which, ſo far as it anſwers to the firſt three bones, is very thick, and divided into two irregular cavities, by a long perpendicular ridge.——The foremoſt of the two cavities has commonly a thin cartilaginous ſkin covering it in the recent ſubject, and is adapted to the unequal protuberance of the os ilium, and a ſtrong ligament connects the circumference of theſe ſurfaces of the two bones.——The cavity behind is divided by a tranſverſe ridge into two, where ſtrong ligamentous ſtrings that go from this bone to the os ilium, with a cellular ſubſtance containing mucus, are lodged.

The tranſverſe proceſſes of the two laſt bones of the os ſacrum are much ſmaller than the former.——At their back-part, near their edge, a knob and oblong flat ſurface give riſe to two ſtrong ligaments which are extended to the os iſchium; and are therefore called *ſacro-ſciatic*.

The ſpinal proceſſes of the three uppermoſt bones of the os ſacrum appear ſhort, ſharp, and almoſt erect, while the two lower ones are open behind; and ſometimes a little knob is to be ſeen on the fourth, though generally it is bifurcated, without the two legs meeting into a ſpine; in which condition alſo the firſt is often to be ſeen. The muſculus latiſſimus, and longiſſimus dorſi, ſacrolumbalis, and glutæus maximus, have part of their origins from theſe ſpinal proceſſes.

The canal between the bodies and proceſſes of this bone, for the cauda equina, is triangular; and becomes ſmaller as it deſcends, as the cauda alſo does.——Below the third bone, this paſſage is no more a complete bony canal, but is open behind; and is only there defended by a ſtrong ligamentous membrane ſtretched over it, which, with the muſcles that cover it, and are very prominent on each ſide, is a ſufficient defence for the bundle of nerves within.

At the root of each oblique proceſs of this bone, the notch is conſpicuous, by which, and ſuch another in the laſt vertebra of the loins, a paſſage is left for the twenty-fourth ſpinal nerve; and, in viewing the os ſacrum, either before or behind, four large holes appear in each ſide, in much the ſame height, as where the marks of the union of its ſeveral bones remain. Some of the largeſt nerves of the body paſs through the anterior holes; and ſuperficial grooves running outwards from them in different directions, ſhew the courſe of theſe nerves.——From the intervals of theſe grooves, the *pyriformis* muſcle chiefly riſes.——The holes in the back-part of the bone are covered by membranes which allow ſmall nerves to paſs through them.——The two uppermoſt of theſe holes, eſpecially on the fore-ſide, are the largeſt; and as the bone deſcends, the holes turn ſmaller. Sometimes a notch is only formed at the lower part in each ſide of this bone; and in other ſubjects there is a hole common to it and the os coccygis, through which the twenty-ninth pair of ſpinal nerves paſſes; and frequently a bony bridge is formed on the back-part of each ſide by a proceſs ſent up from the back-part of the os coccygis, and joined to the little knobs which the laſt bone of the os ſacrum has inſtead of a ſpinal proceſs. Under this bridge or jugum, the twenty-ninth pair of ſpinal nerves runs in its courſe to the common holes juſt now deſcribed.

The ſubſtance of the os ſacrum is very ſpongy, without any conſiderable ſolid external plates, and is lighter proportionally to its bulk than any other bone in the body; but is ſecured from injuries by the thick muſcles that cover it behind, and by the ſtrong ligamentous membranes that cloſely adhere to it.

This bone is articulated above to the laſt vertebra of the loins, in the manner that the lumbar vertebræ are joined; and therefore the ſame motions may be performed here.——The articulation of the lower part of the os ſacrum to the os coccygis ſeems well enough adapted for allowing

allowing confiderable motion to this laft bone, was it not much confined by ligaments. Laterally, the os facrum is joined to the offa ilium by an immoveable fynchondrofis.

The ufes of the os facrum are, to ferve as the common bafe and fupport of the trunk of the body, to guard the nerves proceeding from the end of the fpinal marrow, to defend the back-part of the pelvis, and to afford fufficient origin to the mufcles which move the trunk and thigh.

Os Coccygis, or *rump-bone*, is that triangular chain of bones depending from the os facrum; each bone becoming fmaller as they defcend, till the laft ends almoft in a point. The os coccygis is convex behind, and concave before; from which crooked pyramidal figure, which was thought to refemble a cuckow's beak, it has got its name.

This bone confifts of four pieces in people of middle age:—In children, very near the whole of it is cartilage: In old fubjects, all the bones are united, and become frequently one continued bone with the os facrum.

The higheft of the four bones is the largeft, with fhoulders extended farther to each fide than the end of the os facrum;—the upper furface of this bone is a little hollow.——From the back of that bulbous part called its *fhoulders*, a procefs often rifes up on each fide, to join with the bifurcated fpine of the fourth and fifth bones of the os facrum, to form the bony bridge mentioned in the defcription of the os facrum.——Immediately below the fhoulders of the os coccygis, a notch may be remarked in each fide, where the thirtieth pair of the fpinal nerves paffes.——The lower end of this bone is formed into a fmall head, which very often is hollow in the middle.

The three lower bones gradually become fmaller, and are fpongy; but are ftrengthened by a ftrong ligament which covers and connects them.——Their ends, by which they are articulated, are formed in the fame manner as thofe of the firft bone are.

The lower end of the fourth bone terminates in a rough point, to which a cartilage is appended.

To the fides of thefe bones of the os coccygis, the coccygæi mufcles, and part of the levatores ani, and of the glutæi maximi, are fixed.

The os coccygis ferves to fuftain the inteftinum rectum; and, in order to perform this office more effectually, it is made to turn with a curve forwards; by which alfo the bone itfelf, as well as the mufcles and teguments, is preferved from any injury, when we fit with our body reclined back.

The *fecond* part of the trunk of the fkeleton, the Pelvis, is the cylindrical cavity at the lower part of the abdomen, formed by the os facrum, os coccygis, and offa innominata; which laft therefore fall now in courfe to be examined.

The Ossa Innominata are two large broad bones, which form the fore-part and fides of the pelvis, and the lower part of the fides of the abdomen.—In children each of thefe bones is evidently divided into three; which are afterwards fo intimately united, that fcarce the leaft mark of their former feparation remains: notwithftanding, they are defcribed as confifting each of three bones, to wit, the os ilium, ifchium, and pubis.

Os Ilium, or *haunch-bone*, is fituated higheft of the three, and reaches as far down as one third of the great cavity into which the head of the thigh-bone is received.

The external fide of this bone is unequally convex, and is called its *dorfum*;—the internal concave furface is by fome (but improperly) named *cofta*.——The femicircular edge at the higheft part of this bone, which is tipped with a cartilage in the recent fubject, is named the *fpine*, into which the external or defcending oblique mufcle of the abdomen is inferted; and from it the internal afcending oblique and the tranfverfe mufcles of the belly, with the glutæus maximus, quadratus lumborum, and latiffimus dorfi, have their origin.—The ends of the fpine are more prominent than the furface of the bone below them; therefore are reckoned proceffes.——From the anterior fpinal procefs, the fartorius and fafcialis mufcles have their rife, and the outer end of the doubled tendon of the external oblique mufcle of the abdomen, commonly called *Fallopius*'s or *Poupart*'s ligament, is fixed to it.——The infide of the pofterior fpinal procefs, and of part of the fpine forward from that, is made flat and rough where the facro-lumbalis and longiffimus dorfi rife; and to its outfide ligaments, extended to the os facrum and tranfverfe proceffes of the fifth and fourth vertebræ of the loins, are fixed.——Below the anterior fpinal procefs another protuberance ftands out, which, by its fituation, may be diftinguifhed from the former, by adding the epithet of *inferior*, where the mufculus rectus tibiæ has its origin.—Betwixt thefe two anterior proceffes the bone is hollowed where the beginning of the fartorius mufcle is lodged.——Below the pofterior fpinal proceffes, a fecond protuberance of the edge of this bone is in like manner obfervable, which is clofely applied to the os facrum.——Under this laft procefs a confiderable large niche is obfervable in the os ilium; between the fides of which and the ftrong ligament that is ftretched over from the os facrum to the fharp-pointed procefs of the os ifchium of the recent fubject, a large hole is formed, through which the mufculus pyriformis, the great fciatic nerve, and the pofterior crural veffels, pafs, and are protected from compreffion.

The external broad fide, or dorfum of the os ilium, is a little hollow towards the fore part; farther back it is as much raifed; then is confiderably concave; and, laftly, it is convex. Thefe inequalities are occafioned by the actions of the mufcles that are fituated on this furface.—From behind the uppermoft of the two anterior fpinal proceffes, in fuch bones as are ftrongly marked by the mufcles, a femicircular ridge is extended to the hollow paffage of the fciatic nerve. Between the fpine and this ridge, the glutæus medius takes its rife. Immediately from above the loweft of the anterior fpinal proceffes, a fecond ridge is ftretched to the niche. Between this and the former ridge, the glutæus minimus has its origin. —— On the outfide of the pofterior fpinal proceffes, the dorfum of the os ilium is flat and rough, where part of the mufculus glutæus maximus and pyriformis rifes.——The loweft part of this bone is the thickeft, and is formed into a large

large cavity with high brims, to aſſiſt in compoſing the great acetabulum.

The internal ſurface of the os ilium is concave in its broadeſt fore part, where the internal iliac muſcle has its origin, and ſome ſhare of the inteſtinum ilium and colon is lodged.——From this large hollow, a ſmall ſinuoſity is continued obliquely forwards, at the inſide of the anterior inferior ſpinal proceſs, where part of the pſoas and iliacus muſcles, with the crural veſſels and nerves, paſs.—— The large concavity is bounded below by a ſharp ridge, which runs from behind forwards, and, being continued with ſuch another ridge of the os pubis, forms a line of partition between the abdomen and pelvis.——Into this ridge the broad tendon of the pſoas parvus is inſerted.

All the internal ſurface of the os ilium, behind this ridge, is very unequal: For the upper part is flat, but ſpongy, where the ſacro-lumbalis and longiſſimus dorſi riſe.——Lower down, there is a tranſverſe ridge from which ligaments go out to the os ſacrum.——Immediately below this ridge, the rough unequal cavities and prominences are placed, which are exactly adapted to thoſe deſcribed on the ſide of the os ſacrum.——In the ſame manner, the upper part of this rough ſurface is porous, for the firmer adheſion of the ligamentous cellular ſubſtance; while the lower part is more ſolid, and covered with a thin cartilaginous ſkin, for its immoveable articulation with the os ſacrum.

Os Ischium, or *hip-bone*, is of a middle bulk between the two other parts of the os innominatum, is ſituated loweſt of the three, and is of a very irregular figure.— Its extent might be marked by an horizontal line drawn near through the middle of the acetabulum; for the upper bulbous part of this bone forms ſome leſs than the lower half of that great cavity, and the ſmall leg of it riſes to much the ſame height on the other ſide of the great hole common to this bone and the os pubis.

From the upper thick part of the os iſchium, a ſharp proceſs, called by ſome *ſpinous*, ſtands out backwards, from which chiefly the muſculus coccygæus and ſuperior gemellus, and part of the levator ani, riſe; and the anterior or internal ſacroſciatic ligament is fixed to it.—— Immediately below this proceſs, a ſinuoſity is formed for the tendon of the muſculus obturator internus.——In a recent ſubject, this part of the bone, which ſerves as a pully on which the obturator muſcle plays, is covered with a ligamentous cartilage, that, by two or three ſmall ridges, points out the interſtices of the fibres in the tendon of this muſcle.——The outer ſurface of the bone at the root of this ſpinous proceſs is made hollow by the pyriformis, or iliacus externus muſcle.

Below the ſinuoſity for the obturator muſcle, is the great knob or tuberoſity, covered with cartilage or tendon.——The upper part of the tuberoſity gives riſe to the inferior gemellus muſcle.——To a ridge at the inſide of this, the external or poſterior ſacroſciatic ligament is ſo fixed, that between it, the internal ligament, and the ſinuoſity of the os iſchium, a paſſage is left for the internal obturator muſcle.——The upper thick ſmooth part of the tuber, called by ſome its *dorſum*, has two oblique impreſſions on it. The inner one gives origin to the long head of the biceps flexor tibiæ and ſeminervoſus muſcles, and the ſemimembranoſus riſes from the exterior one, which reaches higher and nearer the acetabulum than the other.——The lower, thinner, more ſcabrous part of the knob which bends forwards, is alſo marked with two flat ſurfaces, whereof the internal is what we lean upon in ſitting, and the external gives riſe to the largeſt head of the triceps adductor femoris.——Between the external margin of the tuberoſity, and the great hole of the os innominatum, there is frequently an obtuſe ridge extended down from the acetabulum, which gives origin to the quadratus femoris.—As the tuber advances forwards, it becomes ſmaller, and is rough, for the origin of the muſculus tranſverſalis and erector penis.—— The ſmall leg of it, which mounts upwards to join the os pubis, is rough and prominent at its edge, where the two lower heads of the triceps or quadriceps adductor femoris take their riſe.

The upper and back part of the os iſchium is broad and thick; but its lower and fore-part is narrower and thinner.

The os ilium and pubis of the ſame ſide are the only bones which are contiguous to the os iſchium.

The Os Pubis, or *ſhare-bone*, is the leaſt of the three parts of the os innominatum, and is placed at the upper fore-part of it.——The thick largeſt part of this bone is employed in forming the acetabulum; from which, becoming much ſmaller, it is ſtretched inwards to its fellow of the other ſide, where again it grows larger, and ſends a ſmall branch downwards to join the end of the ſmall leg of the os iſchium.——The upper fore-part of each os pubis is tuberous and rough where the muſculus rectus and pyramidalis are inſerted.——From this a ridge is extended along the upper edge of the bone, in a continued line with ſuch another of the os ilium, which divides the abdomen and pelvis. The ligament of Fallopius is fixed to the internal end of this ridge, and the ſmooth hollow below it is made by the pſoas and iliacus internus muſcles paſſing with the anterior crural veſſels and nerves behind the ligament.——Some way below the former ridge, another is extended from the tuberous part of the os pubis downwards, and outwards towards the acetabulum; between theſe two ridges the bone is hollow and ſmooth, for lodging the head of the pectineus muſcle.—— Immediately below, where the lower ridge is to take the turn downwards, a winding nitch is made, which is comprehended in the great foramen of a ſkeleton, but is formed into a hole by a ſubtended ligament in the recent ſubject, for the paſſage of the poſterior crural nerve, an artery, and a vein.——The internal end of the os pubis is rough and unequal, for the firmer adheſion of the thick ligamentous cartilage that connects it to its fellow of the other ſide:—The proceſs which goes down from that to the os iſchium is broad and rough before, where the gracilis and upper heads of the triceps, or rather quadriceps adductor femoris, have their origin.

Betwixt the os iſchium and pubis a very large irregular hole is left, which, from its reſemblance to a door or ſhield, has been called *thyroides*. This hole is all, except the nitch for the poſterior crural nerve, filled up, in a recent ſubject, with a ſtrong ligamentous membrane, that

that adheres very firmly to its circumference. From this membrane chiefly the two obturator mufcles, external and internal, take their rife.——The great defign of this hole, befides rendering the bone lighter, is to allow a ftrong enough origin to the obturator mufcles, and fufficient fpace for lodging their bellies, that there may be no danger of difturbing the functions of the contained vifcera of the pelvis by the actions of the internal, nor of the external being bruifed by the thigh-bone, efpecially by its lefſer trochanter, in the motions of the thigh inwards.——The bowels fometimes make their way through the nitch for the veffels, at the upper part of this thyroid hole, which caufes a hernia in this place.

In the external furface of the offa innominata, near the outfide of the great hole, a large deep cavity is formed by all the three bones conjunctly: For the os pubis conftitutes about one fifth; the os ilium makes fomething lefs than two fifths, and the os ifchium as much more than two fifths. The brims of this cavity are very high, and are ftill much more enlarged by the ligamentous cartilage, with which they are tipped in a recent fubject. From this form of the cavity it has been called *acetabulum*; and, for a diftinguifhing character, the name of the bone that conftitutes the largeft fhare of it is added; therefore *acetabulum offis ifchii* is the name this cavity commonly bears.——Round the bafe of the fupercilia the bone is rough and unequal, where the capfular ligament of the articulation is fixed.——The brims at the upper and back-part of the acetabulum are much larger and higher than any where elfe; which is very neceffary to prevent the head of the femur from flipping out of its cavity at this place, where the whole weight of the body bears upon it, and confequently would otherwife be conftantly in danger of thrufting it out.——As thefe brims are extended downwards and forwards, they become lefs; and at their internal lower part a breach is made in them; from the one fide of which to the other, a ligament is placed in the recent fubject; under which a large hole is left, which contains a fatty cellular fubftance and veffels.——Befides this difference in the height of the brims, the acetabulum is otherwife unequal: For the lower internal part of it is depreffed below the cartilaginous furface of the upper-part, and is not covered with cartilage; into the upper-part of this particular depreffion, where it is deepeft and of a femilunar form, the ligament of the thigh-bone, commonly called the *round* one, is inferted; while in its more fuperficial lower part the large mucilaginous gland of this joint is lodged. The largeft fhare of this feparate depreffion is formed in the os ifchium.

The offa innominata are joined at their back-part to each fide of the os facrum by a fort of future, with a very thin intervening cartilage, which ferves as fo much glue to cement thefe bones together; and ftrong ligaments go from the circumference of this unequal furface to connect them more firmly. The offa innominata are connected together at their fore-part by the ligamentous cartilage interpofed between the two offa pubis.—Thefe bones can therefore have no motion in a natural ftate, except what is common to the trunk of the body, or to the os facrum.

Each os innominatum affords a focket (the acetabulum) for the thigh-bones to move in, and the trunk of the body rolls here fo much on the heads of the thigh-bones, as to allow the moft confpicuous motions of the trunk, which are commonly thought to be performed by the bones of the fpine.

The pelvis then has a large open above where it is continued with the abdomen, is ftrongly fenced by bones on the fides, back, and fore-part, and appears with a wide opening below, in the fkeleton; but, in the recent fubject, a confiderable part of the opening is filled by the facrofciatic ligaments, pyriform, internal obturator, levatores ani, gemini, and coccygæi mufcles, which fupport and protect the contained parts better than bones could have done; fo that fpace is only left at the loweft part of it, for the large excretories, the vefica urinaria, inteftinum rectum, and in females, the uterus, to difcharge themfelves.

The THORAX, or *cheft*, reaches from below the neck to the belly; and, by means of the bones that guard it, is formed into a large cavity: The figure of which is fomewhat conoidal.

The bones which form the thorax are the twelve dorfal *vertebræ* behind, the *ribs* on the fides, and the *fternum* before.

The *vertebræ* have already been defcribed as part of the fpine.

The RIBS, or *coftæ*, (as if they were *cuftodes*, or guards, to thofe principal organs of the animal machine, the heart and lungs), are the long crooked bones placed at the fide of the cheft, in an oblique direction downwards in refpect of the back-bone.——Their number is generally twelve on each fide; though frequently eleven or thirteen have been found.

The ribs are all concave internally; where they are alfo made fmooth by the action of the contained parts, which, on this account, are in no danger of being hurt by them; and they are convex externally, that they might refift that part of the preffure of the atmofphere, which is not balanced by the air within the lungs, during infpiration.——The ends of the ribs next the vertebræ are rounder than they are after thefe bones have advanced forwards, when they become flatter and broader, and have an upper and lower edge, each of which is made rough by the action of the intercoftal mufcles, inferted into them.—The upper edge of the ribs is more obtufe and rounder than the lower, which is depreffed on its internal fide by a long foffa, for lodging the intercoftal veffels and nerves; on each fide of which there is a ridge, to which the intercoftal mufcles are fixed. The foffa is not obfervable however at either end of the ribs: for, at the pofterior or root, the veffels have not yet reached the ribs; and, at the fore-end, they are fplit away into branches, to ferve the parts between the ribs.

At the pofterior end of each rib, a little head is formed, which is divided by a middle ridge into two plain or hollow furfaces; the loweft of which is the broadeft and deepeft in moft of them. The two plains are joined to the bodies of two different vertebræ, and the ridge forces itfelf into the intervening cartilage.—

A little way from this head, we find, on the external surface, a small cavity, where mucilaginous glands are lodged; and round the head, the bone appears spongy, where the capsular ligament of the articulation is fixed.——Immediately beyond this a flatted tubercle rises, with a small cavity at, and roughness about its root, for the articulation of the rib with the transverse process of the lowest of the two vertebræ, with the bodies of which the head of the rib is joined.—Advancing further on this external surface, we observe in most of the ribs another smaller tubercle, into which ligaments which connect the ribs to each other, and to the transverse processes of the vertebræ, and portions of the longissimus dorsi, are inserted.——Beyond this the ribs are made flat by the sacro-lumbalis muscle, which is inserted into the part of this flat surface farthest from the spine, where each rib makes a considerable curve, called by some its *angle*.——Then the rib begins to turn broad, and continues so to its anterior end, which is hollow and spongy, for the reception of, and firm coalition with the cartilage that runs thence to be inserted into the sternum, or to be joined with some other cartilage.

To the fore-end of each rib a long broad and strong cartilage is fixed, and reaches thence to the sternum, or is joined to the cartilage of the next rib. This course, however, is not in a streight line with the rib; for generally the cartilages make a considerable curve, the concave part of which is upwards; therefore, at their insertion into the sternum, they make an obtuse angle above, and an acute one below.—These cartilages, as all others, are firmer and harder internally, than they are on their external surface.

The ribs then are articulated at each end, of which the one behind is doubly joined to the vertebræ; for the head is received into the cavities of two bodies of the vertebræ, and the larger tubercle is received into the depression in the transverse process of the lower vertebra.

Hitherto we have laid down the general structure and connection of the ribs, and shall next mark their differences.

In viewing the ribs from above downwards, their figure is still streighter; the uppermost being the most crooked of any.—Their obliquity, in respect of the spine, increases as they descend; so that though their distances from each other is very little different at their back-part, yet at their fore-ends the distances between the lower ones must increase.

The length of the ribs increases from the first and uppermost rib, as far down as the seventh; and from that to the twelfth, as gradually diminishes.——The superior of the two plain, or rather hollow surfaces, by which the ribs are articulated to the bodies of the vertebræ, gradually increases from the first to the fourth rib, and is diminished after that in each lower rib.——The distance of their angles from the heads always increases as they descend to the ninth, because of the greater breadth of the sacro-lumbalis muscle.

The ribs are commonly divided into *true* and *false*.

The *true* costæ are the seven upper ones of each side, whose cartilages are all gradually longer as the ribs descend, and are joined to the breast-bone; so that being pressed constantly between two bones, they are flatted at both ends, and are thicker, harder, and more liable to ossify, than the other cartilages that are not subject to so much pressure. These ribs include the heart and lungs; and therefore are the proper or true custodes of life.

The five inferior ribs of each side are the *false* or *bastard*, whose cartilages do not reach to the sternum; and therefore, wanting the resistance at their fore-part, they are there pointed; and, on this account, having less pressure, their substance is softer.——The cartilages of these false ribs are shorter as the ribs descend.——To all these five ribs the circular edge of the diaphragm is connected; and its fibres, instead of being stretched immediately transversely, and so running perpendicular to the ribs, are pressed so as to be often, especially in expiration, parallel to the plane in which the ribs lie.

The first rib of each side is so situated, that the flat sides are above and below, while one edge is placed inwards, and the other outwards, or nearly so; therefore sufficient space is left above it for the subclavian vessels and muscle; and the broad concave surface is opposed to the lungs: But then, in consequence of this situation, the channel for the intercostal vessels is not to be found, and the edges are differently formed from all the other, except the second; the lower one being rounded, and the other sharp.——The head of this rib is not divided into two plain surfaces by a middle ridge, because it is only articulated with the first vertebra of the thorax.——Its cartilage is ossified in adults, and is united to the sternum at right angles.—Frequently this first rib has a ridge rising near the middle of its posterior edge, where one of the heads of the scalenus muscle rises.——Farther forward it is flatted, or sometimes depressed by the clavicle.

The fifth, sixth, and seventh, or rather the sixth, seventh, eighth, and sometimes the fifth, sixth, seventh, eighth, ninth ribs, have their cartilages at least contiguous; and frequently they are joined to each other by cross cartilages; and most commonly the cartilages of the eighth, ninth, tenth, are connected to the former, and to each other, by firm ligaments.

The eleventh, and sometimes the tenth rib, has no tubercle for its articulation with the transverse process of the vertebra, to which it is only loosely fixed by ligaments.—The fossa in its lower edge is not so deep as in the upper ribs, because the vessels run more towards the interstice between the ribs.—Its fore-end is smaller than its body, and its short small cartilage is but loosely connected to the cartilage of the rib above.

The twelfth rib is the shortest and streightest.—Its head is only articulated with the last vertebra of the thorax; therefore is not divided into two surfaces.—This rib is not joined to the transverse process of the vertebra, and therefore has no tubercle, being often pulled necessarily inwards by the diaphragm, which an articulation with the transverse process would not have allowed.—The fossa is not found at its under edge, because the vessels run below it.—The fore-part of this rib is smaller than its middle, and has only a very small-pointed cartilage fixed to it.—To its whole internal side the diaphragm is connected.

The

The Sternum, or *breast-bone*, is the broad flat bone or pile of bones, at the fore-part of the thorax.—In adults of a middle age, it is composed of three bones, which easily separate after the cartilages connecting them are destroyed. Frequently the two lower bones are found intimately united; and very often in old people, the sternum is a continued bony substance from one end to the other; though we still observe two, sometimes three, transverse lines on its surface; which are marks of the former divisions.

When we consider the sternum as one bone, we find it broadest and thickest above, and becoming smaller as it descends. The internal surface of this bone is somewhat hollowed for enlarging the thorax; but the convexity on the external surface is not so conspicuous, because the sides are pressed outwards by the true ribs; the round heads of whose cartilages are received into seven smooth pits, formed in each side of the sternum, and are kept firm there by strong ligaments, which, on the external surface, have a particular radiated texture.—The pits at the upper part of the sternum are at the greatest distance one from another, and, as they descend, are nearer; so that the two lowest are contiguous.

The first of the three bones that compose the sternum, all agree, is somewhat of the figure of a heart, as it is commonly painted; only it does not terminate in a sharp point.——This is the uppermost thickest part of the sternum.

The upper middle part of this first bone, where it is thickest, is hollowed, to make place for the trachea arteria; though this cavity is principally formed by the bone being raised on each side of it, partly by the clavicles thrusting it inwards, and partly by the sterno-mastoidei muscles pulling it upwards.——On the outside of each tubercle, there is an oblong cavity, that, in viewing it transversely from before backwards, appears a little convex: Into these glenæ the ends of the clavicles are received.—In the side of the under end of this first bone, the half of the pit for the second rib on each side is formed.——The upper part of the surface behind is covered with a strong ligament, which secures the clavicles.

The second or middle division of this bone, is much longer, narrower, and thinner than the first; but, excepting that it is a little narrower above than below, it is nearly equal all over in its dimensions of breadth or thickness.——In the sides of it are complete pits for the third, fourth, fifth, and sixth ribs, and an half of the pits for the second and seventh.

The third bone is much less than the other two, and has only one half of the pit for the seventh rib formed in it; wherefore it might be reckoned only an appendix of the sternum.——In young subjects it is always cartilaginous, and is better known by the name of *cartilago xiphoides*, or *ensiformis*, than any other; though the ancients often called the whole *sternum ensiforme*.—This third bone is seldom of the same figure, magnitude, or situation in any two subjects; for sometimes it is a plain triangular bone, with one of the angles below, and perpendicular to the middle of the upper side, by which it is connected to the second bone.——In other people, the point is turned to one side, or obliquely forwards or backwards.—Frequently it is all nearly of an equal breadth, and in several subjects it is bifurcated; whence some writers give it the name of *furcella*, or *furcula inferior*; or else it is unossified in the middle.——In the greatest number of adults it is ossified, and tipped with a cartilage; in some, one half of it is cartilaginous; and in others, it is all in a cartilaginous state.—Generally several oblique ligaments, fixed at one end to the cartilages of the ribs, and by the other to the outer surface of the xiphoid-bone, connect it firmly to those cartilages.

The uses of the sternum are, to afford origin and insertion to several muscles; to sustain the mediastinum, to defend the vital organs, the heart and lungs, at the fore-part; and, lastly, by serving as a moveable fulcrum of the ribs, to assist considerably in respiration.

OF THE SUPERIOR EXTREMITIES.

Each superior extremity is divided into the *shoulder*, *arm*, *fore-arm*, and *hand*.

The Shoulder consists of the *clavicle* and *scapula*

Clavicula, or *collar-bone*, is the long crooked bone, in figure like like an Italic *ſ*, placed almost horizontally between the upper lateral part of the sternum, and what is commonly called the top of the shoulder, which, as a clavis or beam, it bears off from the trunk of the body.

The clavicle, as well as other long round bones, is larger at its two ends than in the middle. The end next to the sternum is triangular: The angle behind is considerably produced, to form a sharp ridge, to which the transverse ligament extended from one clavicle to the other is fixed.—The side opposite to this is somewhat rounded.—The middle of this protuberant end is as irregularly hollowed, as the cavity in the sternum for receiving it is raised; but, in a recent subject, the irregular concavities of both are supplied by a moveable cartilage, which is not only much more closely connected every where, by ligaments, to the circumference of the articulation, than those of the lower jaw are; but it grows to the two bones at both its internal and external ends; its substance at the internal end being soft, but very strong, and resembling the intervertebral cartilages.

From this internal end the clavicle, for about two fifths of its length, is bended obliquely forwards and downwards. On the upper and fore-part of this curvature a small ridge is seen, with a plain rough surface before it; whence the musculus sterno-hyoideus and sterno-mastoideus have in part their origin.—Near the lower angle, a small plain surface is often to be remarked, where the first rib and this bone are contiguous, and are connected by a firm ligament.——From this a rough plain surface is extended outwards, where the pectoral muscle has part of its origin.——Behind, the bone is made flat and rough by the insertion of the larger share of the subclavian muscle. —— After the clavicle begins to be bended backwards, it is round, but soon after becomes broad and thin; which shape it retains to its external end.——Along the external concavity, a rough sinuosity runs, from which some part of the deltoid muscle takes its rise: ——Opposite to this, on the convex edge, a scabrous

ridge gives infertion to a fhare of the cucullaris mufcle. The upper furface of the clavicle here is flat; but the lower is hollow, for lodging the beginning of the mufculus fubclavius; and towards its back-part a tubercle rifes, to which, and a roughnefs near it, the ftrong fhort thick ligament connecting this bone to the coracoid procefs of the fcapula is fixed.

The external end of this bone is horizontally oblong, fmooth, floping at the pofterior fide, and tipped in a recent fubject with a cartilage, for its articulation with the acromion fcapulæ.

The medullary arteries, having their direction obliquely outwards, enter the clavicles by one or more fmall paffages in the middle of their back-part.

The triangular unequal interior end of each clavicle, has the cartilage above defcribed interpofed betwixt it and the irregular cavity of the fternum.——The ligaments, which furround this articulation to fecure it, are fo fhort and ftrong, that little motion can be allowed any way; and the ftrong ligament that is ftretched acrofs the upper furcula of the fternum, from the pofterior prominent angle of the one clavicle, to the fame place of the other clavicle, ferves to keep each of thefe bones more firmly in their place.——By the affiftance, however, of the moveable intervening cartilage, the clavicle can, at this joint, be raifed or depreffed, and moved backwards and forwards fo much, as that the external end, which is at a great diftance from that axis, enjoys very confpicuous motions.

The ufes of the clavicles are, to keep the fcapulæ, and confequently all the fuperior extremities, from falling in and forward upon the thorax.

SCAPULA, or *fhoulder-blade*, is the triangular bone fituated on the outfide of the ribs, with its longeft fide, called its *bafe*, towards the fpinal proceffes of the vertebræ, and with the angle at the upper part of this fide about three inches, and the lower angle at a greater diftance from thefe proceffes.—The back-part of the fcapula has nothing but the thin ends of the ferratus anticus major, and fubfcapularis mufcles, between it and the ribs: But as this bone advances forwards, its diftance from the ribs increafes.—The upper, or fhorteft fide, called the *fuperior cofta* of the fcapula, is nearly horizontal, and parallel with the fecond rib.—The lower fide, which is named the *inferior cofta*, is extended obliquely from the third to the eighth rib.——The inferior angle of the fcapula is very acute; and the upper one is near to a right angle.——The body of this bone is concave towards the ribs, and convex behind, where it has the name of *dorfum*.——Three proceffes are generally reckoned to proceed from the fcapula.——The firft is the large fpine that rifes from its convex furface behind, and divides it unequally.——The fecond procefs ftands out from the fore-part of the upper fide; and, from its imaginary refemblance to a crow's beak, is named *coracoides*.——The third procefs is the whole thick bulbous fore-part of the bone.

After thus naming the feveral conftituent parts of the fcapula, the particular defcription will be more eafily underftood.

The bafe, which is tipped with cartilage, is not all ftreight: For, above the fpine, it runs obliquely forwards to the fuperior angle; that here it might not be too protuberant backwards, and fo bruife the mufcles and teguments: Into the oblique fpace the mufculus patientiæ is inferted.——At the root of the fpine, on the back-part of the bafe, a triangular plain furface is formed, by the preffure of the lower fibres of the trapezius.—— Below this the edge of the fcapula is fcabrous and rough, for the infertion of the ferratus major anticus, and rhomboid mufcles.

The back-part of the inferior angle is made fmooth by the latiffimus dorfi paffing over it. This mufcle alfo alters the direction of the inferior cofta, fome way forwards from this angle: and fo far it is flatted behind by the origin of the teres major.——As the inferior cofta advances forwards, it is of confiderable thicknefs, is flightly hollowed and made fmooth behind by the teres minor, while it has a foffa formed into it below by part of the fubfcapularis; and between the two a ridge, with a fmall depreffion, appears, where the longus extenfor cubiti has its origin.

The fuperior cofta is very thin; and near its fore-part there is a femilunar nitch, from one end of which to the other a ligament is ftretched; and fometimes the bone is continued, to form one, or fometimes two holes, for the paffage of the fcapular blood-veffels and nerves. ——Immediately behind this femilunar cavity, the coraco-hyoid mufcle has its rife.——From the nitch, to the termination of the foffa for the teres minor, the fcapula is narrower than any where elfe, and fupports the third procefs. This part has the name of *cervix*.

The whole dorfum of the fcapula is always faid to be convex; but, by reafon of the raifed edges that furround it, it is divided into two cavities by the fpine, which is ftretched from behind forwards, much nearer to the fuperior than to the inferior cofta.——The cavity above the fpine is concave where the fupra-fpinatus mufcle is lodged; while the furface of this bone below the fpine, on which the infra-fpinatus mufcle is placed, is convex, except a foffa that runs at the fide of the inferior cofta.

The internal or anterior furface of this bone is hollow, except in the part above the fpine, which is convex.—— The fubfcapularis mufcle is extended over this furface, where it forms feveral ridges and intermediate depreffions, commonly miftaken for prints of the ribs; they point out the interftices of the bundles of fibres of which the fubfcapularis mufcle is compofed.

The fpine rifes fmall at the bafe of the fcapula, and becomes higher and broader as it advances forwards.—— On the fides it is unequally hollowed and crooked, by the actions of the adjacent mufcles.——Its ridge is divided into two rough flat furfaces: Into the upper one, the trapezius mufcle is inferted; and the lower one has part of the deltoid fixed to it.——The end of the fpine, called *acromion*, or top of the fhoulder, is broad and flat, and is fometimes only joined to the fpine by a cartilage.——The anterior edge of the acromion is flat, fmooth, and covered with a cartilage, for its articulation with the external end of the clavicle; and it is hollowed below, to allow a paffage to the infra and fupra-fpinati mufcles, and free motion to the os humeri.

The

The coracoid proceſs is crooked, with its point inclining forwards; ſo that a hollow is left at the lower ſide of its root, for the paſſage of the infra-ſcapularis muſcle. ——The end of this proceſs is marked with three plain ſurfaces. Into the internal, the ſerratus minor anticus is inſerted: From the external, one head of the biceps flexor cubiti riſes; and from the lower one, the coraco-brachialis has its origin.——At the upper part of the root of this proceſs, immediately before the ſemilunar cavity, a ſmooth tubercle appears, where a ligament from the clavicle is fixed. From all the external ſide of this coracoid apophyſe, a broad ligament goes out, which becomes narrower where it is fixed to the acromion.

From the cervix ſcapulæ the third proceſs is produced. The fore-part of this is formed into a glenoid cavity, which is of the ſhape of the longitudinal ſection of an egg, being broad below, and narrow above.—Between the brims of this hollow, and the fore-part of the root of the ſpine, a large ſinuoſity is left, for the tranſmiſſion of the ſupra and infra-ſpinati muſcles; and, on the upper part of theſe brims, we may remark a ſmooth ſurface, where the ſecond head of the biceps flexor cubiti has its origin.—— The root of the ſupercilia is rough all round, for the firmer adheſion of the capſular ligament of the articulation, and of the cartilage which is placed on theſe brims, where it is thick, but becomes very thin as it is continued towards the middle of the cavity, which it lines all over.

The medullary veſſels enter the ſcapula near the baſe of the ſpine.

The ſcapula and clavicle are joined by plain ſurfaces, tipped with cartilage; by which neither bone is allowed any conſiderable motion, being tightly tied down by the common capſular ligament, and by a very ſtrong one which proceeds from the coracoid proceſs; but divides into two before it is fixed into the clavicle, with ſuch a direction, as either can allow this bone to have a ſmall rotation, in which its poſterior edge turns more backwards, while the anterior one riſes farther forwards; or it can yield to the fore-part of the ſcapula moving downwards, while the back-part of it is drawn upwards; in both which caſes, the oblong ſmooth articulated ſurfaces of the clavicle and ſcapula are not in the ſame plane, but ſtand a little tranſverſely, or acroſs each other, and thereby preſerve this joint from luxations, to which it would be ſubject, if either of the bones was to move on the other perpendicularly up and down, without any rotation.—The ſcapula is connected to the head, os hyoides, vertebræ, ribs, and arm-bone, by muſcles, that have one end faſtened to theſe bones, and the other to the ſcapula, which can move it upwards, downwards, backwards, or forwards; by the quick ſucceſſion of theſe motions, its whole body is carried in a circle.

The uſe of the ſcapula is, to ſerve as a fulcrum to the arm; and, by altering its poſition on different occaſions, to allow always the head of the os humeri a right ſituated ſocket to move in; and thereby to aſſiſt and to enlarge greatly the motions of the ſuperior extremity, and to afford the muſcles which riſe from it more advantageous actions, by altering their directions to the bone which they are to move.

The Arm has only one bone, beſt known by the Latin name of *os humeri*; which is long, round, and nearly ſtreight.

The upper end of this bone is formed into a large, round, ſmooth head, whoſe middle point is not in a ſtreight line with the axis of the bone, but ſtands obliquely backwards from it.——The extent of the head is diſtinguiſhed by a circular foſſa ſurrounding its baſe, where the head is united to the bone, and the capſular ligament of the joint is fixed.——Below the fore-part of its baſe two tubercles ſtand out: The ſmalleſt one, which is ſituated moſt to the inſide, has the tendon of the ſubſcapularis muſcle inſerted into it.——The larger more external protuberance is divided, at its upper part, into three ſmooth plain ſurfaces; into the anterior of which, the muſculus ſupra-ſpinatus; into the middle or largeſt, the infra-ſpinatus; into the one behind, the teres minor, is inſerted.——Between theſe two tubercles, exactly in the fore part of the bone, a deep long foſſa is formed, for lodging the tendinous head of the biceps flexor cubiti.——On each ſide of this foſſa, as it deſcends in the os humeri, a rough ridge, gently flatted in the middle, runs from the roots of the tubercles.——The tendon of the pectoral muſcle is fixed into the anterior of theſe ridges, and the latiſſimus dorſi, and teres major, are inſerted into the internal one.——A little behind the lower end of this laſt, another rough ridge may be obſerved, where the coraco-brachialis is inſerted. ——From the back-part of the root of the largeſt tubercle, a ridge alſo is continued, from which the brevis extenſor cubiti riſes.——This bone is flatted on the inſide, about its middle, by the belly of the biceps flexor cubiti.——In the middle of this plain ſurface, the entry of the medullary artery is ſeen ſlanting obliquely downwards.——At the fore-ſide of this plane, the bone riſes in a ſort of ridge, which is rough, and often has a great many ſmall holes in it, where the tendon of the ſtrong deltoid muſcle is inſerted; on each ſide of which the bone is ſmooth and flat, where the brachiæus internus riſes. The exterior of theſe two flat ſurfaces is the largeſt; behind it a ſuperficial ſpiral channel, formed by the muſcular nerve and the veſſels that accompany it, runs from behind forwards and downwards.—The body of the os humeri is flatted behind by the extenſors of the fore-arm.——Near the lower end of this bone, a large ſharp ridge is extended on its outſide, from which the muſculus ſpinator radii longus, and the longeſt head of the extenſor carpi radialis riſe.—Oppoſite to this, there is another ſmall ridge, to which the aponeurotic tendon, that gives origin to the fibres of the internal and external brachiæi muſcles, is fixed; and from a little depreſſion on the fore-ſide of it, the pronator radii teres riſes.

The body of the os humeri becomes gradually broader towards the lower end, where it has ſeveral proceſſes; at the roots of which there is a cavity before, and another behind. The anterior is divided, by a ridge, into two; the external, which is the leaſt, receives the end of the radius; and the internal receives the coronoid proceſs of the ulna in the flection of the fore-arm, while the poſterior deep triangular cavity lodges the olecranon in the extenſions of that member.—The ſides of the

the posterior cavity are stretched out into two processes, one on each side: These are called *condyles;* from each of which a strong ligament goes out to the bones of the fore-arm.—The external condyle, which has an oblique direction also forwards in respect of the internal, when the arm is in the most natural posture, is equally broad, and has an obtuse smooth head rising from it forwards.—From the rough part of the condyle, the inferior head of the bicornis, the extensor digitorum communis, extensor carpi ulnaris, anconœus, and some part of the supinator radii brevis, take their rise; and on the smooth head the upper end of the radius plays.—Immediately on the outside of this, there is a sinuosity made by the shorter head of the bicornis muscle, upon which the muscular nerve is placed.——The internal condyle is more pointed and protuberant than the external, to give origin to some part of the flexor carpi radialis, pronator radii teres, palmaris longus, flexor digitorum sublimis, and flexor carpi ulnaris.—Between the two condyles, is the trochlea or pully, which consists of two lateral protuberances, and a middle cavity, that are smooth, and covered with cartilage.—When the fore-arm is extended, the tendon of the internal brachiœus muscle is lodged in the fore-part of the cavity of this pully.—The external protuberance, which is less than the other, has a sharp edge behind; but forwards, this ridge is obtuse, and only separated from the little head, already described, by a small fossa, in which the joined edges of the ulna and radius move.—The internal protuberance of the pully is largest and highest; and therefore, in the motions of the ulna upon it, that bone would be inclined outwards, was it not supported by the radius on that side.——Between this internal protuberance and condyle, a sinuosity may be remarked, where the ulnar nerve passes.

The round head at the upper end of this bone is articulated with the glenoid cavity of the scapula; which being superficial, and having long ligaments, allows the arm a free and extensive motion.

The motions which the arm enjoys by this articulation, are to every side; and by the succession of these different motions, a circle may be described. Besides which, the bone performs a small rotation round its own axis.

The Fore-arm consists of two long bones, the ulna and radius; whose situation, in respect of each other, is oblique in the least straining or most natural posture; that is, the ulna is not directly behind, nor on the outside of the radius, but in a middle situation between these two, and the radius crosses it.—In the following description, by the term *posterior* is meant that part which is in the same direction with the back of the hand; by *anterior*, that answering to the palm; by *internal*, that on the same side with the thumb; by *external*, the side nearest the little finger.

Ulna, so named from its being used as a measure, is the longest of the two bones of the fore-arm, and situated on the outside of the radius.

At the upper end of the ulna are two processes.—The posterior is the largest, and formed like a hook, whose concave surface moves upon the pully of the os humeri, and is called *olecranon,* or top of the cubit.—The convex back-part of it is rough and scabrous, where the longus, brevis, and brachiœus externus, are inserted. The olecranum makes it unnecessary that the tendons of the extensor muscles should pass over the end of the os humeri; which would have been of ill consequence in the great flections of this joint, or when any considerable external force is applied to this part.—The anterior process is not so large, nor does it reach so high as the one behind; but is sharper at its end, and therefore is named *coronoid.*—Between these two processes, a large semicircular or sigmoid concavity is left; the surface of which, on each side of a middle rising, is slanting, and exactly adapted to the pully of the bone of the arm.——Across the middle of it, there is a small sinuosity for lodging mucilaginous glands; where, as well as in a small hollow on the internal side of it, the cartilage that lines the rest of its surface is wanting.—Round the brims of this concavity the bone is rough, where the capsular ligament of the joint is implanted.——Immediately below the olecranon, on the back-part of the ulna, a flat, triangular, spongy surface appears, on which we commonly lean.—At the internal side of this, there is a larger hollow surface, where the musculus anconœus is lodged; and the ridge at the inside of this gives rise to the musculus supinator radii brevis.——Between the top of the ridge and the coronoid process, is the semilunated smooth cavity, lined with cartilage, in which, and a ligament extended from the one to the other end of this cavity, the round head of the radius plays.—Immediately below it, a rough hollow gives lodging to mucilaginous glands.—Below the root of the coronoid process, this bone is scabrous and unequal, where the brachiœus internus is inserted.—On the outside of that, we observe a smooth concavity, where the beginning of the flexor digitorum profundus sprouts out.

The body of the ulna is triangular.—The internal angle is very sharp where the ligament that connects the two bones is fixed;—the sides, which make this angle, are flat and rough, by the action and adhesion of the many muscles which are situated here.—At the distance of one third of the length of the ulna from the top, in its fore-part, the passage of the medullary vessels is to be remarked slanting upwards.—The external side of this bone is smooth, somewhat convex, and the angles at each edge of it are blunted by the pressure of the muscles equally disposed about them.

As this bone descends, it becomes gradually smaller; so that its lower end terminates in a little head, standing on a small neck.——Towards the fore but outer part of which last, an oblique ridge runs, that gives rise to the pronator radii quadratus.——The head is round, smooth, and covered with a cartilage on its internal side, to be received into the semilunar cavity of the radius; while a styloid process rises from its outside, to which is fixed a strong ligament that is extended to the os cuneiforme and pisiforme of the wrist.—Between the back-part of that internal smooth side and this process, a sinuosity is left for the tendon of the extensor carpi ulnaris,——On the fore-part of the root of the process, such another depression may be remarked for the passage of the ulnar artery and nerve.—The end of the bone is smooth, and covered with a cartilage.—Between it and the bones of the

the wrift, a double concave moveable cartilage is interpofed; which is a continuation of the cartilage that covers the lower end of the radius, and is connected loofely to the root of the ftyloid procefs, and to the rough cavity there, in which mucilaginous glands are lodged.

The ulna is articulated above with the lower end of the os humeri, where thefe bones have depreffions and protuberances correfponding to each other, fo as 10 allow an eafy and fecure extenfion of the fore-arm to almoft a ftreight line with the arm, and flection to a very acute angle; but, by the flanting pofition of the pully, the lower part of the fore-arm is turned outwards in the extenfion, and inwards in the flection; and a very fmall kind of rotation is likewife allowed in all pofitions, efpecially when the ligaments are moft relaxed by the fore-arm being in a middle degree of flection.——The ulna is alfo articulated with the radius and carpus, in a manner to be related afterwards.

Radius, fo called from its imagined refemblance to a fpoke of a wheel, is the bone placed at the infide of the fore-arm. Its upper end is formed into a circular little head, which is hollowed for an articulation with the tubercle at the fide of the pully of the os humeri; and the half of the round circumference of the head next to the ulna is fmooth, and covered with a cartilage, in order to be received into the femilunated cavity of that bone. ——Below the head, the radius is much fmaller; therefore this part is named its *cervix*, which is made round by the action of the fupinator radii brevis.——At the external root of this neck, a tuberous procefs rifes; into the outer part of which the biceps flexor cubiti is inferted.——From this a ridge runs downwards and inwards, where the fupinator radii brevis is inferted; and a little below, and behind this ridge, there is a rough fcabrous furface, where the pronator radii teres is fixed.

The body of the radius is not ftreight, but convex on its internal and pofterior furfaces; where it is alfo made round by the equal preffure of the circumjacent mufcles, particularly of the extenfors of the thumb; but the furfaces next to the ulna are flatted and rough, for the origin of the mufcles of the hand; and both terminate in a common fharp fpine, to which the ftrong ligament extended betwixt the two bones of the fore-arm is fixed. A little below the beginning of the plain furface, on its fore-part, where the flexor mufcle of the laft joint of the thumb takes its origin, the paffage of the medullary veffels is feen flanting upwards.——The radius becomes broader and flatter towards the lower end, efpecially on its fore-part, where its pronator quadratus mufcle is fituated.

The lower end of the radius is larger than the fuperior; though not in fuch a difproportion as the upper end of the ulna is larger than its lower end.——Its back-part has a flat ftrong ridge in the middle, and foffæ on each fide.——In a fmall groove immediately on the outfide of the ridge, the tendon of the extenfor tertii internodii pollicis plays.—In a large one beyond this, the tendons of the indicator and of the common extenfor mufcles of the fingers pafs.—Contiguous to the ulna, there is a fmall depreffion made by the extenfor minimi digiti. —On the outfide of the ridge there is a broad depreffion, which feems again fubdivided, where the two tendons of the bicornis, or extenfor carpi radialis, are lodged.—The internal fide of this end of the radius is alfo hollowed by the extenfors of the firft and fecond joint of the thumb; immediately above which, a little rough furface fhews where the fupinator radii longus is inferted.—The ridges at the fides of the grooves, in which the tendons play, have an annular ligament fixed to them, by which the feveral fheaths for the tendons are formed.—The fore-part of this end of the radius is alfo depreffed, where the flexors of the fingers and flexor carpi radialis pafs.—— The external fide is formed into a femilunated fmooth cavity, lined with a cartilage, for receiving the lower end of the ulna.—The loweft part of the radius is formed into an oblong cavity; in the middle of which is a fmall tranfverfe rifing, gently hollowed, for lodging mucilaginous glands; while the rifing itfelf is infinuated into the conjunction of the two bones of the wrift that are received into the cavity.—The internal fide of this articulation is fenced by a remakable procefs of the radius, from which a ligament goes out to the wrift, as the ftyloid procefs of the ulna with its ligament guards it on the outfide.

The ends of both the bones of the fore-arm being thicker than the middle, there is a confiderable diftance between the bodies of thefe bones; in the larger part of which a ftrong tendinous, but thin ligament, is extended, to give a large enough furface for the origin of the numerous fibres of the mufcles fituated here, that are fo much funk between the bones, as to be protected from injuries, which they would otherwife be expofed to.

As the head of the radius receives the tubercle of the os humeri, it is not only bended and extended along with the ulna, but may be moved round its axis in any pofition; and that this motion round its axis may be fufficiently large, the ligament of the articulation is extended farther down than ordinary on the neck of this bone, before it is connected to it; and it is very thin at its upper and lower part, but makes a firm ring in the middle.— This bone is alfo joined to the ulna by a double articulation; for above, a tubercle of the radius plays in a focket of the ulna; whilft below, the radius gives the focket, and the ulna the tubercle: But then the motion performed in thefe two is very different; for, at the upper end, the radius does no more than turn round its axis; while, at the lower end, it moves in a fort of cycloid upon the round part of the ulna; and as the hand is articulated and firmly connected here with the radius, they muft move together.—When the palm is turned uppermoft, the radius is faid to perform the *fupination;* when the back of the hand is above, it is faid to be *prone*.

The Hand comprehends all from the joint of the wrift to the points of the fingers. Its back-part is convex, for greater firmnefs and ftrength; and it is concave before, for containing more furely and conveniently fuch bodies as we take hold of.

The hand is commonly divided into the *carpus*, *metacarpus*, and *fingers*.

The Carpus is compofed of eight fmall fpongy bones, fituated at the upper part of the hand, *viz.* the

os ſcaphoides, lunare, cuneiforme, piſiforme, trapezium, trapezoides, magnum, unciforme.

The ſcaphoides is ſituated moſt internally of thoſe that are articulated with the fore-arm.—The lunare is immediately on the outſide of the former.—The cuneiforme is placed ſtill more externally, but does not reach ſo high up as the other two.—The piſiforme ſtands forwards into the palm from the cuneiforme.—The trapezium is the firſt of the ſecond row, and is ſituated betwixt the ſcaphoides and firſt joint of the thumb.—The trapezoides is immediately on the outſide of the trapezium.—The os magnum is ſtill more external.—The unciforme is farther to the ſide of the little finger.

Os ſcaphoides is the largeſt of the eight except one. It is convex above, concave and oblong below; from which ſmall reſemblance of a boat it has got its name.—Its ſmooth convex ſurface is divided by a rough middle foſſa, which runs obliquely croſs it.—The upper largeſt diviſion is articulated with the radius.—Into the foſſa the common ligament of the joint of the wriſt is fixed; and the lower diviſion is joined to the trapezium and trapezoides.—The concavity receives more than an half of the round head of the os magnum.—The external ſide of this hollow is formed into a ſemilunar plane, to be articulated with the following bone.—The internal, poſterior, and anterior edges are rough, for fixing the ligaments that connect it to the ſurrounding bones.

Os lunare has a ſmooth convex upper ſurface, by which it is articulated with the radius.——The internal ſide, which gives the name to the bone, is in the form of a creſcent, and is joined with the ſcaphoid;—the lower ſurface is hollow, for receiving part of the head of the os magnum.——On the outſide of this cavity is another ſmooth, but narrow oblong ſinuoſity, for receiving the upper end of the os unciforme:—On the outſide of which a ſmall round convexity is found, for its connection with the os cuneiforme. Between the great convexity above, and the firſt deep inferior cavity, there is a rough foſſa, in which the circular ligament of the joint of the wriſt is fixed.

Os cuneiforme is broader above, and towards the back of the hand, than it is below and forwards: which gives it the reſemblance of a wedge.——The ſuperior ſlightly convex ſurface is included in the joint of the wriſt, being oppoſed to the lower end of the ulna.—Below this, the cuneiform bone has a rough foſſa, wherein the ligament of the articulation of the wriſt is fixed.—On the internal ſide of this bone, where it is contiguous to the os lunare, it is ſmooth and ſlightly concave.—Its lower ſurface, where it is contiguous to the os unciforme, is oblong, ſomewhat ſpiral, and concave.—Near the middle of its anterior ſurface, a circular plane appears, where the os piſiforme is ſuſtained.

Os piſiforme is almoſt ſpherical, except one circular plane, or ſlightly hollow ſurface, which is covered with cartilage for its motion on the cuneiforme bone, from which its whole rough body is prominent forwards into the palm; having the tendon of the flexor carpi ulnaris, and a ligament from the ſtyloid proceſs of the ulna, fixed to its upper part; the tranſverſe ligament of the wriſt is connected to its internal ſide; ligaments extended to the unciform bone, and to the os metacarpi of the little finger, are attached to its lower part; the abductor minimi digiti has its origin from its fore-part; and, at the internal ſide of it, a ſmall depreſſion is formed, for the paſſage of the ulnar nerve.

Trapezium has four unequal ſides and angles in its back-part, from which it has got its name.——Above, its ſurface is ſmooth, ſlightly hollowed, and ſemicircular, for its conjunction with the os ſcaphoides.——Its external ſide is an oblong concave ſquare, for receiving the following bone.——The inferior ſurface is formed into a pulley; the two protuberant ſides of which are external and internal. On this pulley the firſt bone of the thumb is moved.——At the external ſide of the external protuberance, a ſmall oblong ſmooth ſurface is formed by the os metacarpi indicis.—The fore-part of the trapezium is prominent in the palm, and, near to the external ſide, has a ſinuoſity in it, where the tendon of the flexor carpi radialis is lodged; on the ligamentous ſheath of which the tendon of the flexor tertii internodii pollicis plays: And ſtill more externally the bone is ſcabrous, where the tranſverſe ligament of the wriſt is connected, the abductor and flexor primi internodii pollicis have their origin, and ligaments go out to the firſt bone of the thumb.

Os trapezoides, ſo called from the irregular quadrangular figure of its back-part, is the ſmalleſt bone of the wriſt, except the piſiforme.—The figure of it is an irregular cube.—It has a ſmall hollow ſurface above, by which it joins the ſcaphoides; a long convex one internally, where it is contiguous to the trapezium; a ſmall external one, for its conjunction with the os magnum; and an inferior convex ſurface, the edges of which are however ſo raiſed before and behind, that a ſort of pulley is formed, where it ſuſtains the os metacarpi indicis.

Os magnum, ſo called becauſe it is the largeſt bone of the carpus, is oblong, having four quadrangular ſides, with a round upper end, and a triangular plain one below.—The round head is divided by a ſmall riſing, oppoſite to the connection of the os ſcaphoides and lunare, which together form the cavity for receiving it.—On the inſide, a ſhort plain ſurface joins the os magnum to the trapezoides.—On the outſide is a long narrow concave ſurface, where it is contiguous to the os unciforme.——The lower end, which ſuſtains the metacarpal bone of the middle finger, is triangular, ſlightly hollowed, and farther advanced on the internal ſide than on the external, having a conſiderable oblong depreſſion made on the advanced inſide by the metacarpal bone of the fore-finger; and generally there is a ſmall mark of the os metacarpi digiti annularis on its external ſide.

Os unciforme has got its name from a thin broad proceſs that ſtands out from it forwards into the palm, and is hollow on its inſide, for affording paſſage to the tendons of the flexors of the fingers. To this proceſs alſo the tranſverſe ligament is fixed, that binds down and defends theſe tendons; and the flexor and abductor muſcles of the little finger have part of their origin from it.—The upper plain ſurface is ſmall, convex, and joined with the os lunare:—The internal ſide is long, and ſlightly convex, adapted to the contiguous os magnum:

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The external ſurface is oblique, and irregularly convex, to be articulated with the cuneiform bone :—The lower end is divided into two concave ſurfaces ; the external is joined with the metacarpal bone of the little finger, and the internal one is fitted to the metacarpal bone of the ring-finger.

The uſes of the carpus are, to ſerve as a baſe to the hand, to protect its tendons, and to afford it a free large motion.

Metacarpus conſiſts of four bones, which ſuſtain the fingers.——Each bone is long and round, with its ends larger than its body.——The upper end, which ſome call the *baſe*, is flat and oblong, without any conſiderable head or cavity ; but it is however ſomewhat hollowed, for the articulation with the carpus : It is made flat and ſmooth on the ſides where theſe bones are contiguous to each other.——Their bodies are flatted on their back-part by the tendons of the extenſors of the fingers.——The anterior ſurface of theſe bodies is a little concave, eſpecially in their middle; along which a ſharp ridge ſtands out, which ſeparates the muſculi interoſſei placed on each ſide of theſe bones, which are there made flat and plain by theſe muſcles.

Their lower ends are raiſed into large oblong ſmooth heads, whoſe greateſt extent is forwards from the axis of the bone.—At the fore-part of each ſide of the root of each of theſe heads, one or two tubercles ſtand out, for fixing the ligaments that go from one metacarpal bone to another, to preſerve them from being drawn aſunder :—Round the heads a rough ring may be remarked, for the capſular ligaments of the firſt joints of the fingers to be fixed to; and both ſides of theſe heads are flat, by preſſing on each other.

The concavity on the fore-part of theſe metacarpal bones, and the placing their baſis on the arched carpus, cauſe them to form a hollow in the palm of the hand, which is uſeful often to us.—The ſpaces between them lodge muſcles, and their ſmall motion makes them fit ſupporters for the fingers to play on.

Though the oſſa metacarpi ſo far agree, yet they may be diſtinguiſhed from each other by the following marks.

The os metacarpi indicis is generally the longeſt.—Its baſe, which is articulated with the os trapezoides, is hollow in the middle.——The ſmall ridge on the internal ſide of this oblong cavity is ſmaller than the one oppoſite to it, and is made flat on the ſide by the trapezium.——The exterior ridge is alſo ſmooth, and flat on its outſide, for its conjunction with the os magnum ; immediately below which, a ſemicircular ſmooth flat ſurface ſhews the articulation of this to the ſecond metacarpal bone.—The back-part of this baſe is flatted, where the long head of the extenſor carpi radialis is inſerted ; and its fore-part is prominent, where the tendon of the flexor carpi radialis is fixed.—The external ſide of the body of this bone is more hollowed by the action of muſcles, than the internal.—The tubercle at the internal root of its head is larger than the external.—Its baſe is ſo firmly fixed to the bone it is connected with, that it has no motion.

Os metacarpi medii digiti is generally the ſecond in length.—Its baſe is a broad ſuperficial cavity, ſlanting outwards ; the internal poſterior angle of which is ſo prominent, as to have the appearance of a proceſs.——The internal ſide of this baſe is made plain in the ſame way as the external ſide of the former bone, while its external ſide has two hollow circular ſurfaces, for joining the third metacarpal bone ; and between theſe ſurfaces there is a rough foſſa, for the adheſion of a ligament, and lodging mucilaginous glands.——The ſhorter head of the bicornis is inſerted into the back-part of this baſe.——The two ſides of this bone are almoſt equally flatted ; only the ridge on the fore-part of the body inclines outwards.——The tubercles at the fore-part of the root of the head are equal.——The motion of this bone is very little more than the firſt metacarpal one has ; and therefore theſe two firmly reſiſt bodies preſſed againſt them by the thumb, or fingers, or both.

Os metacarpi digiti annularis is ſhorter than the ſecond metacarpal bone.—Its baſe is ſemicircular and convex, for its conjunction with the os unciforme.—On its internal ſide are two ſmooth convexities, and a middle foſſa, adapted to the ſecond metacarpal bone.—The external ſide has a triangular ſmooth concave ſurface to join it with the fourth one. The anterior ridge of its body is ſituated more to the out than to the in-ſide.—The tubercles near the head are equal.—The motion of this third metacarpal bone is greater than the motion of the ſecond.

Os metacarpi minimi digiti is the ſmalleſt and ſharpeſt.—Its baſe is irregularly convex, and riſes ſlanting outwards.—Its internal ſide is exactly adapted to the third metacarpal bone.—The external has no ſmooth ſurface, becauſe it is not contiguous to any other bone ; but it is prominent where the extenſor carpi ulnaris is inſerted.—As this metacarpal bone is furniſhed with a proper moving muſcle, has the plaineſt articulation, is moſt looſely connected and leaſt confined, it not only enjoys a much larger motion than any of the reſt, but draws the third bone with it, when the palm of the hand is to be made hollow by its advancement forwards, and by the prominence of the thumb oppoſite to it.

The Thumb and four Fingers are each compoſed of three long bones.

The thumb is ſituated obliquely in reſpect of the fingers, neither oppoſite directly to them, nor in the ſame plane with them.—All its bones are much thicker and ſtronger in proportion to their length, than the bones of the fingers are : Which was extremely neceſſary, ſince the thumb counteracts all the fingers.

The firſt bone of the thumb has its baſe adapted to the double pulley of the trapezium.—The edge at the fore-part of this baſe is produced farther than any other part ; and round the back-part of the baſe a rough foſſa may be ſeen, for the connection of the ligaments of this joint.—The body and head of this bone are of the ſame ſhape as the oſſa metacarpi : only that the body is ſhorter, and the head flatter, with the tubercles at the fore-part of its root larger.

The articulation of the upper end of this bone is uncommon : For though it has protuberances and depreſſions adapted to the double pulley of the trapezium ; yet it enjoys a circular motion, as the joints do where a round

round head of one bone plays in the orbicular ſocket of another; only it is ſomewhat more confined and leſs expeditious, but ſtronger and more ſecure, than ſuch joints generally are.

The ſecond bone of the thumb has a large baſe formed into an oblong cavity, whoſe greateſt length is from one ſide to the other.—Round it ſeveral tubercles may be remarked, for the inſertion of ligaments.—Its body is convex, or a half-round behind; but flat before, for lodging the tendon of the long flexor of the thumb, which is tied down by ligamentous ſheaths that are fixed on each ſide to the angle at the edge of this flat ſurface.

The articulation and motion of the upper end of this ſecond bone is as ſingular as that of the former.—For its cavity being joined to the round head of the firſt bone, it would ſeem at firſt view to enjoy motion in all directions; yet, becauſe of the ſtrength of its lateral ligaments, oblong figure of the joint itſelf, and mobility of the firſt joint, it only allows flection and extenſion; and theſe are generally much confined.

The third bone of the thumb is the ſmalleſt, with a large baſe, whoſe greateſt extent is from one ſide to the other.——This baſe is formed into two cavities and a middle protuberance, to be adapted to the pulley of the former bone.——Its body is rounded behind; but is flatter than in the former bone, for ſuſtaining the nail.—It is flat and rough before, by the inſertion of the flexor tertii internodii.——This bone becomes gradually ſmaller, till near the lower end, where it is a little enlarged, and has an oval ſcabrous edge.

The motion of this third bone is confined to flection and extenſion.

The orderly diſpoſition of the bones of the fingers into three rows, has made them generally obtain the name of three *phalanges*.———All of them have half-round convex ſurfaces, covered with an aponeuroſis, formed by the tendons of the extenſors, lumbricales, and interoſſei, and placed directly backwards, for their greater ſtrength; and their flat concave part is forwards, for taking hold more ſurely, and for lodging the tendons of the flexor muſcles.———The ligaments for keeping down theſe tendons are fixed to the angles that are between the convex and concave ſides.

The bones of the firſt phalanx of the fingers anſwer to the deſcription of the ſecond bone of the thumb: only that the cavity in their baſe is not ſo oblong; nor is their motion on the metacarpal bones ſo much confined; for they can be moved laterally or circularly, but have no rotation, or a very ſmall degree of it, round their axis.

The ſecond bone of the fingers has its baſe formed into two lateral cavities, and a middle protuberance; while the lower end has two lateral protuberances, and a middle cavity; therefore it is joined at both ends in the ſame manner, which none of the bones of the thumb are.

The third bone differs nothing from the deſcription of the third bone of the thumb, excepting in the general diſtinguiſhing marks; and therefore the ſecond and third phalanx of the fingers enjoy only flection and extenſion.

All the difference of the phalanges of the ſeveral fingers conſiſts in their magnitude.———The bones of the middle-finger being the longeſt and largeſt.—Thoſe of the fore-finger come next to that in thickneſs, but not in length, for thoſe of the ring-finger are a little longer. The little finger has the ſmalleſt bones. Which diſpoſition is the beſt contrivance for holding the largeſt bodies; becauſe the longeſt fingers are applied to the middle largeſt periphery of ſuch ſubſtances as are of a ſperical figure.

The uſes of all the parts of our ſuperior extremities are ſo evident in the common actions of life, that it is needleſs to enumerate them here; and therefore we ſhall proceed to the laſt part of the ſkeleton.

OF THE INFERIOR EXTREMITIES.

The Inferior Extremities depend from the acetabula of the oſſa innominata; are commonly divided into three parts, *viz.* the *thigh*, *leg*, and *foot*.

The Thigh has only one bone; which is the longeſt of the body. The ſituation of it is not perpendicular; for the lower end is inclined conſiderably inwards: So that the knees are almoſt contiguous, while there is a conſiderable diſtance between the thigh-bones above: Which is of good uſe to us, ſince ſufficient ſpace is thereby left for the external parts of generation, the two great cloacæ of urine and fœces, and for the large thick muſcles that move the thigh inwards: And, at the ſame time, this ſituation of the thigh-bones renders our progreſſion quicker, ſurer, ſtreighter, and in leſs room.

The upper end of the thigh-bone is not continued in a ſtreight line with the body of it, but is ſet off obliquely inwards and upwards, whereby the diſtance here between theſe two bones at their upper part is conſiderably increaſed.——This end is formed into a large ſmooth round head, which is the greater portion of a ſphere unequally divided.——Towards its lower internal part, a round rough ſpongy pit is obſervable, where the ſtrong ligament, commonly called the *round* one, is fixed, to be extended from thence to the lower internal part of the receiving cavity, where it is conſiderably broader than near to the head of the thigh-bone.——The ſmall part below the head, called the *cervix*, of the os femoris, has a great many large holes, into which the fibres of the ſtrong ligament, continued from the capſular, enter, and are thereby ſurely united to it; and round the root of the neck, where it riſes from the bone, a rough ridge is found, where the capſular ligament of the articulation itſelf is connected.———Below the back-part of this root, the large unequal protuberance, called *trochanter major*, ſtands out; the external convex part of which is diſtinguiſhed into three different ſurfaces, whereof the one on the fore-part is ſcabrous and rough, for the inſertion of the glutæus minimus; the ſuperior one is ſmooth, and has the glutæus medius inſerted into it; and the one behind is made flat and ſmooth by the tendon of the glutæus maximus paſſing over it.———The upper edge of this proceſs is ſharp and pointed at its back-part, where the glutæus medius is fixed; but forwards it is more obtuſe, and has two ſuperficial pits formed in it: Into the ſuperior of theſe, the piriformis is implanted; and the obturator internus and gemini are fixed into the lower one.

one.——From the backmoſt prominent part of this great trochanter, a rough ridge runs backwards and downwards, into which the quadratus is inſerted.—— In the deep hollow, at the internal upper ſide of this ridge, the obturator externus is implanted.——More internally, a conoid proceſs, called *trochanter minor*, riſes, for the inſertion of the muſculus pſoas and iliacus internus, and the pectineus is implanted into a rough hollow below its internal root.——The muſcles inſerted into theſe two proceſſes being the principal inſtruments of the rotatory motion of the thigh, have occaſioned the name of *trochanters* to the proceſſes.

The body of the os femoris is convex on the fore-part, and made hollow behind, by the action of the muſcles that move it and the leg, and for the conveniency of ſitting, without bearing too much on theſe muſcles.—— The fore-part of the thigh-bone is a little flatted above by the beginning of the cruræus muſcle, as it is alſo below by the ſame muſcle and the rectus.——Its external ſurface is likewiſe made flat below by the vaſtus externus, where it is ſeparated from the former by an obtuſe ridge. ——The vaſtus internus depreſſes a little the lower part of the internal ſurface.——The poſterior concave ſurface has a ridge riſing in its middle, commonly called *linea aſpera*, into which the triceps is inſerted, and the ſhort head of the biceps flexor tibiæ riſes from it.—— At the upper part of it, the medullary veſſels enter by a ſmall hole that runs obliquely upwards.—A little above which, there is a rough foſſa or two, where the tendon of the glutæus maximus is fixed.——The lower end of the linea aſpera divides into two, which deſcend towards each ſide.——The two vaſti muſcles have part of their origin from theſe ridges; and the long tendon of the triceps is fixed to the internal, by means of part of the faſcia aponeurotica of the thigh.——Near the beginning of the internal ridge, there is a diſcontinuation of the ridge, where the crural artery paſſes through the aponeuroſis.——Between theſe two rough lines, the bone is made flat by the large blood-veſſels and nerves which paſs upon it; and near the end of each of theſe ridges, a ſmall ſmooth protuberance may often be remarked, where the two heads of the external gaſtrocnemius muſcle take their riſe; and from the fore-part of the internal tubercle, a ſtrong ligament is extended to the inſide of the tibia.

The lower end of the os femoris is larger than any other part of it, and is formed into a great protuberance on each ſide, called its *condyles*; between which a conſiderable cavity is found, eſpecially at the back-part, in which the crural veſſels and nerves lie immerſed in fat. ——The internal condyle is longer than the external.— Each of theſe proceſſes ſeems to be divided in its plain ſmooth ſurface. The mark of diviſion on the external is a notch, and on the internal a ſmall protuberance. The fore-part of this diviſion, on which the rotula moves, is formed like a pulley, the external ſide of which is higheſt.——Behind, there are two oblong large heads, whoſe greateſt extent is backwards, for the motion of the tibia; and from the rough cavity between them, but near to the baſe of the internal condyle, the ſtrong ligament, commonly called the croſs one, has its riſe.——A little above which, a rough protuberance gives inſertion to the tendon of the triceps.——The condyles, both on the outer and inner ſide of the knee, are made flat by the muſcles paſſing along them.——On the back part of the internal, a ſlight depreſſion is made by the tendons of the gracilis and ſartorius; and on the external, ſuch another is formed by the biceps flexor cruris; behind which, a deep foſſa is to be obſerved, where the poplitæus muſcle has its origin.——From the tubercle immediately before this cavity, a ſtrong round ligament goes out to the upper part of the fibula.——Round this lower end of the thigh-bone, large holes are found, into which the ligaments for the ſecurity of the joint are fixed, and blood-veſſels paſs to the internal ſubſtance of the bone.

The thigh-bone being articulated above with the acetabulum of the oſſa innominata, which affords its round head a ſecure and extenſive play, can be moved to every ſide; but is reſtrained in its motion outwards by the high brims of the cavity, and by the round ligament; for otherwiſe the head of the bone would have been frequently thruſt out at the breach of the brims on the inſide, which allows the thigh to move conſiderably inwards. ——The body of this bone enjoys little or no rotatory motion, though the head moſt commonly moves round its own axis; becauſe the oblique progreſs of the neck and head from the bone is ſuch, that the rotatory motion of the head can only bring the body of the bone forwards and backwards.——The os femoris is articulated below to the tibia and rotula in the manner afterwards to be deſcribed.

The nearneſs of the ſmall neck to the round head of the thigh-bone, and its upper end being covered with very thick muſcles, make greater difficulty in diſtinguiſhing between a luxation and fracture here, than in any other part of the body.

The Leg is compoſed of three bones, *tibia*, *fibula*, and *rotula*.

Tibia, ſo called from its reſemblance to an old muſical pipe or flute, is the long, thick, triangular bone, ſituated at the internal part of the leg, and continued in almoſt a ſtreight line from the thigh-bone.

The upper end of the tibia is large, bulbous, and ſpongy, and is divided into two cavities by a rough irregular protuberance, which is hollow at its moſt prominent part, as well as before and behind. The anterior of the two ligaments that compoſe the great croſs one, is inſerted into the middle cavity, and the depreſſion behind receives the poſterior ligament.—The two broad cavities at the ſides of this protuberance are not equal; for the internal is oblong and deep, to receive the internal condyle of the thigh-bone; while the external is more ſuperficial and rounder, for the external condyle.——In each of theſe two cavities of a recent ſubject, a ſemilunar cartilage is placed, which is thick at its convex edge, and becomes gradually thinner towards the concave or interior edge.——The middle of each of theſe cartilages is broad, and the ends of them turn narrower and thinner, as they approach the middle protuberance of the tibia.——The thick convex edge of each cartilage is connected to the capſular and other ligaments of the articulation, but ſo near to their riſe from the tibia, that the

cartilages

cartilages are not allowed to change place far; while the narrow ends of the cartilages, becoming almoſt ligaments, are fixed at the inſertion of the ſtrong croſs ligament into the tibia, and ſeem to have their ſubſtance united with it; therefore a circular hole is left between each cartilage and the ligament, in which the moſt prominent convex part of each condyle of the thigh-bone moves.——The circumference of theſe cavities is rough and unequal, for the firm connection of the ligaments of the joint.—Immediately below the edge, at its back-part, two rough flatted protuberances ſtand out: Into the internal, the tendon of the ſemimembranoſus muſcle is inſerted; and a part of the croſs ligament is fixed to the external.——On the outſide of this laſt tubercle, a ſmooth ſlightly-hollowed ſurface is formed by the action of the poplitæus muſcle.

Below the fore-part of the upper end of the tibia, a conſiderable rough protuberance riſes, to which the ſtrong tendinous ligament of the rotula is fixed.——On the internal ſide of this, there is a broad, ſcabrous, ſlightly-hollowed ſurface, to which the internal long ligament of the joint, the aponeuroſis of the vaſtus internus, and the tendons of the ſeminervoſus, gracilis, and ſartorius, are fixed.—Below the external edge of the upper end of the tibia, there is a circular flat ſurface, covered, in a recent ſubject, with cartilage, for the articulation of the fibula;—between which and the anterior knob, there is a rough hollow, from which the tibialis anticus, and extenſor digitorum longus, take their origin.—From the ſmooth flat ſurface, a ridge runs obliquely downwards and inwards, to give riſe to part of the ſolæus, tibialis poſticus, and flexor digitorum longus, and inſertion to the aponeuroſis of the ſemimembranoſus which covers the poplitæus, and to ſome of the external fibres of this laſt named muſcle.—At the inſide of this ridge an oblique plain ſurface is left, where the greateſt part of the muſculus poplitæus is inſerted.—The remaining body of the tibia is triangugular.—The anterior angle is very ſharp, and is commonly called the *ſpine* or *ſhin*. This ridge is not ſtreight; but turns firſt inwards, then outwards, and laſtly inwards again.—The plain internal ſide is ſmooth and equal, being little ſubjected to the actions of muſcles; but the external ſide is hollowed above by the tibialis anticus, and below by the extenſor digitorum longus, and extenſor pollicis longus.—The two angles behind theſe ſides are rounded by the action of the muſcles;—the poſterior ſide comprehended between them is not ſo broad as thoſe already mentioned, but is more oblique and flatted by the action of the tibialis poſticus and flexor digitorum longus.—Some way above the middle of the bone, the internal angle terminates, and the bone is made round by the preſſure of the muſculus ſolæus.—Near to this, the paſſage of the medullary veſſels is ſeen ſlanting obliquely downwards.

The lower end of the tibia is made hollow, but ſo as a ſmall protuberance riſes in the middle.—The internal ſide of this cavity, which is ſmooth, and, in a recent ſubject, is covered with cartilage, is produced into a conſiderable proceſs, commonly named *malleolus internus*; the point of which is divided by a notch, and from it ligaments are ſent out to the foot.——The external ſide of this end of the tibia has a rough irregular ſemilunar cavity formed in it, for receiving the lower end of the fibula.——The poſterior ſide has two lateral grooves, and a ſmall middle protuberance. In the internal depreſſion, the tendons of the muſculus tibialis poſticus, and flexor digitorum longus, are lodged; and in the external, the tendon of the flexor longus pollicis plays.——From the middle protuberance, ligamentous ſheaths go out, for tying down theſe tendons.

Fibula is the ſmall long bone, placed on the outſide of the leg, oppoſite to the external angle of the tibia; the ſhape of it is irregularly triangular.

The head of the fibula has a ſuperficial circular cavity formed on its inſide, which, in a recent ſubject, is covered with a cartilage, but ſo cloſely connected to the tibia by ligaments, as to allow only a ſmall motion backwards and forwards.—This head is protuberant and rough on its outſide, where a ſtrong round ligament, and the muſculus biceps, are inſerted; and, below the back-part of its internal ſide, a tubercle may be remarked, that gives riſe to the ſtrong tendinous part of the ſolæus muſcle.

The body of this bone is a little crooked inwards and backwards, which figure is owing to the actions of the muſcles; but is ſtill further increaſed by nurſes, who often hold children careleſsly by the legs.——The ſharpeſt angle of the fibula is forwards, on each ſide of which the bone is conſiderably, but unequally, depreſſed by the bellies of the ſeveral muſcles that riſe from, or act upon it; and, in old people, theſe muſcles make diſtinct ſinuoſities for themſelves.——The external ſurface of the fibula is depreſſed obliquely from above downwards and backwards, by the two peronæi.——Its internal ſurface is unequally divided into two narrow longitudinal planes, by an oblique ridge extended from the upper part of the anterior angle, to join with the lower end of the internal angle. To this ridge the ligament ſtretched between the two bones of the leg is connected.——The anterior of the two planes is very narrow above, where the extenſor longus digitorum, and extenſor longus pollicis, a riſe from it; but is broader below, where it has the print of the nonus Veſalii.—The poſterior plane is broad and hollow, giving origin to the larger ſhare of the tibialis poſticus.—The internal angle of this bone has a tendinous membrane fixed to it, from which fibres of the flexor digitorum longus take their riſe.—The poſterior ſurface of the fibula is the plaineſt and ſmootheſt, but is made flat above by the ſolæus, and is hollowed below by the flexor pollicis longus.—In the middle of this ſurface the canal for the medullary veſſels may be ſeen ſlanting downwards.

The lower end of the fibula is extended into a ſpongy oblong head, on the inſide of which is a convex, irregular, and frequently a ſcabrous ſurface, that is received by the external hollow of the tibia, and ſo firmly joined to it by a very thin intermediate cartilage and ſtrong ligaments, that it ſcarce can move.—Below this, the fibula is ſtretched out into a coronoid proceſs, that is ſmooth, covered with cartilage on its internal ſide, and is there contiguous to the outſide of the firſt bone of the foot, the aſtragalus, to ſecure the articulation. This proceſs, named *malleolus externus*, being ſituated farther back

back than the internal malleolus, and in an oblique direction, obliges us naturally to turn the fore-part of the foot outwards. At the lower internal part of this process, a ſpongy cavity for mucilaginous glands may be remarked; from its point, ligaments are extended to the aſtragalus, os calcis, and os naviculare, bones of the foot; and from its inſide, ſhort ſtrong ones go out to the aſtragalus. On the back-part of it, a ſinuoſity is made by the tendons of the peronæi muſcles.—When the ligament extended over theſe tendons from the one ſide of the depreſſion to the other is broke, ſtretched too much, or made weak by a ſprain, the tendons frequently ſtart forwards to the outſide of the fibula.

The conjunction of the upper end of the fibula with the tibia is, by plain ſurfaces, tipped with cartilage; and, at its lower end, the cartilage ſeems to glue the two bones together, not, however, ſo firmly in young people, but that the motion at the other end of ſuch a long radius is very obſervable.

The principal uſe of this bone is to afford origin and inſertion to muſcles; the direction of which may be a little altered, on proper occaſions, by its upper part ſhuffling backwards and forwards.——It likewiſe helps to make the articulation of the foot more ſecure and firm.

Rotula is the ſmall flat bone ſituated at the fore-part of the joint of the knee.——Its ſhape reſembles the common figure of the heart with its point downwards.—The anterior convex ſurface of the rotula is pierced by a great number of holes, into which fibres of the ſtrong ligament that is ſpread over it enter.——Behind, its ſurface is ſmooth, covered with cartilage, and divided by a middle convex ridge into two cavities, of which the external is largeſt, and both are exactly adapted to the pulley of the os femoris, on which they are placed in the moſt ordinary unſtraining poſtures of the leg; but when the leg is much bended, the rotula deſcends far down on the condyles; and when the leg is fully extended, the rotula riſes higher, in its upper part, than the pulley of the thigh-bone.——The plain ſmooth ſurface is ſurrounded by a rough prominent edge, to which the capſular ligament adheres:—Below, the point of the bone is ſcabrous, where the ſtrong tendinous ligament from the tubercle of the tibia is fixed.—The upper horizontal part of this bone is flatted and unequal, where the tendons of the extenſors of the leg are inſerted.

The ſubſtance of the rotula is cellular, with very thin external firm plates: But then theſe cells are ſo ſmall, and ſuch a quantity of bone is employed in their formation, that ſcarce any bone of its bulk is ſo ſtrong. Beſides, it is covered all over with a thick ligament, to connect its ſubſtance, and is moveable to one ſide or other; therefore is ſufficiently ſtrong to reſiſt the ordinary actions of the large muſcles that are inſerted into it, or any common external force applied to it.

The parts which conſtitute the joint of the knee being now deſcribed, let us examine what are its motions, and how performed.——The two principal motions are flection and extenſion.——In the former of theſe, the leg may be brought to a very acute angle with the thigh, by the condyles of the thigh-bones being round and made ſmooth far backwards. In performing this, the rotula is pulled down by the tibia.——When the leg is to be extended, the rotula is drawn upwards, conſequently the tibia forwards, by the extenſor muſcles; which, by means of the protuberant joint, and of this thick bone with its ligament, have in effect the chord, with which they act, fixed to the tibia at a conſiderable angle, therefore act with advantage; but are reſtrained from pulling the leg farther than to a ſtreight line with the thigh, by the poſterior part of the croſs ligament, that the body might be ſupported by a firm perpendicular column: For at this time the thigh and leg are as little moveable in a rotatory way, or to either ſide, as if they were one continued bone.——But when the joint is a little bended, the rotula is not tightly braced, and the poſterior ligament is relaxed; therefore this bone may be moved a little to either ſide, or with a ſmall rotation in the ſuperficial cavities of the tibia; which is done by the motion of the external cavity backwards and forwards, the internal ſerving as a ſort of axis. Seeing then one part of the croſs ligament is ſituated perpendicularly, and the poſterior part is ſtretched obliquely from the internal condyle of the thigh outwards, that poſterior part of the croſs ligament prevents the leg's being turned at all inwards; but it could not hinder it from turning outwards almoſt round, was not that motion confined by the lateral ligaments of this joint, which can yield little.

The Foot is divided into three parts, viz. *tarſus*, *metatarſus*, and *toes:* In the deſcription of which, the broad of the foot ſhall be called *ſuperior*; the ſole, *inferior*; the ſide on which the great toe is, *internal*; that where the little toe is, *external*

The tarſus conſiſts of ſeven ſpongy bones; to wit, the *aſtragalus*, *os calcis*, *naviculare*, *cuboides*, *cuneiforme externum*, *cuneiforme medium*, and *cuneiforme internum*.

The aſtragalus is the uppermoſt of theſe bones.——The os calcis is below the aſtragalus, and is conſiderably prominent backwards beyond the other bones, to form the heel.——The os naviculare is in the middle of the internal ſide of the tarſus.——The os cuboides is the moſt external of the row of four bones at its fore-part.——The os cuneiforme externum is placed at the inſide of the cuboid.——The cuneiforme medium is between the external and internal cuneiform bones, and the internal cuneiform is put at the internal ſide of the foot.

In the deſcription of theſe bones, let it be obſerved, That where-ever a ridge is mentioned, without a particular uſe aſſigned, a ligament is underſtood to be fixed to it: or where a ſpongy rough cavity, depreſſion, or foſſa, is remarked, without naming its uſe, a ligament is inſerted, and mucilaginous glands are lodged.

The upper part of the aſtragalus is formed into a large ſmooth head, which is ſlightly hollowed in the middle; and therefore reſembles a ſuperficial pulley, by which it is fitted to the lower end of the tibia.——The internal ſide of this head is flat and ſmooth, to play on the internal malleolus.——The external ſide has alſo ſuch a ſurface, but larger, for its articulation with the external malleolus.——Round the baſe of this head there is a rough foſſa; and, immediately before the head, as alſo below

below its internal ſmooth ſurface, we find a conſiderable rough cavity.

The lower ſurface of the aſtragalus is divided by an irregular, deep, rough foſſa; which, at its internal end, is narrow, but gradually widens, as it ſtretches obliquely outwards and forwards.—The ſmooth ſurface, covered with cartilage, behind this foſſa, is large, oblong, extended in the ſame oblique ſituation with the foſſa, and concave, for its conjunction with the os calcis.——The back-part of the edge of this cavity is produced into two ſharp-pointed rough proceſſes, between which is a depreſſion, made by the tendon of the flexor pollicis longus.—The lower ſurface before the foſſa is convex, and compoſed of three diſtinct ſmooth planes. The long one behind, and the exterior or ſhorteſt, are articulated with the heel-bone; while the internal, which is the moſt convex of the three, reſts and moves upon a cartilaginous ligament, that is continued from the calcaneum to the os ſcaphoides.

The fore-part of this bone is formed into a convex oblong ſmooth head, which is received by the os naviculare.—Round the root of this head, eſpecially on the upper ſurface, a rough foſſa may be remarked.

The aſtragalus is articulated above to the tibia and fibula, which together form one cavity. Though, in this articulation, the bones have prominences and cavities ſo ſmall, as might allow motions in all directions; yet the flection and extenſion are the moſt conſiderable, the other motions being confined by the malleoli, and by the ſtrong ligaments which go out from the points of theſe proceſſes to the aſtragalus and os calcis. The aſtragalus is joined below to the os calcis; and before, to the os naviculare, in the manner to be explained when theſe bones are deſcribed.

Calcaneum is the largeſt bone of the ſeven.—Behind, it is formed into a large knob, commonly called the *heel:* The ſurface of which is rough behind, where the tendo Achillis is inſerted into it; and above, it is hollow and ſpongy. Farther forwards, on the upper ſurface of the calcaneum, there is an irregular, oblong, ſmooth convexity, adapted to the concavity at the back-part of the aſtragalus: And beyond this a narrow foſſa is ſeen, which divides it from two ſmall concave ſmooth ſurfaces, that are joined to the fore-part of the aſtragalus.—Behind the poſterior of theſe ſmooth ſurfaces, which is the largeſt, a ſmall ſinuoſity is made by the tendon of the flexor digitorum longus; at the fore-part of which a ſmall rough protuberance appears, that gives riſe to the muſculus extenſor digitorum brevis.

The external ſide of this bone is flat, with a ſuperficial foſſa running horizontally, in which the tendon of the muſculus peronæus longus is lodged.—The internal ſide of the heel-bone is hollowed, for lodging the origin of the maſſa cornea Jac. Sylvii, and for the ſafe paſſage of tendons, nerves, and arteries.—Under the ſide of the internal ſmooth concavity, a particular groove is made by the tendon of the flexor pollicis longus; and from the thin protuberance on this internal ſide, the cartilaginous ligament that ſupports the aſtragalus, goes out to the os naviculare; on which ligament, and on the edge of this bone to which it is fixed, the groove is formed for the tendon of the flexor digitorum profundus.

The lower ſurface of this bone is preſſed flat at the back-part, by the weight of our bodies; and immediately before this plane, there are two tubercles, from the internal of which the muſculus abductor pollicis, flexor digitorum ſublimis, as alſo part of the aponeuroſis plantaris, and of the abductor minimi digiti, have their origin; and the other part of the abductor minimi digiti and aponeuroſis plantaris, riſes from the external.——Before theſe protuberances this bone is concave, for lodging the flexor muſcles; and at its fore-part we may obſerve a rough depreſſion, from which, and a tubercle behind it, the ligament goes out that prevents this bone to be ſeparated from the os cuboides.

The fore-part of the os calcis is formed into an oblong, pulley-like, ſmooth ſurface, which is circular at its upper external end, but is pointed below. This ſmooth ſurface is fitted to the os cuboides.

Though the ſurfaces by which the aſtragalus and os calcis are articulated, ſeem fit enough for motion; yet the very ſtrong ligaments by which theſe bones are connected, prevent it, and render this principal part of our baſe, which reſts on the ground, to wit, the os calcis, firm.

Os naviculare, is ſomewhat circular.—It is formed into an oblong concavity behind, for receiving the anterior head of the aſtragalus.—On the upper ſurface, there is a rough foſſa.—Below, the os naviculare is very unequal and rough; but hollow for the ſafety of the muſcles.—On its inſide, a large knob riſes out, from which the abductor pollicis takes in part its origin, the tendon of the tibialis poſticus is inſerted into it, and to it two remarkable ligaments are fixed; the firſt is the ſtrong one, formerly mentioned, which ſupports the aſtragalus; the ſecond is ſtretched from this bone obliquely croſs the foot, to the metatarſal bones of the middle toe, and of the toe next to the little one.—On the outſide of the os naviculare, there is a ſemicircular ſmooth ſurface, where it is joined to the os cuboides.—The fore-part of this bone is all covered with cartilage, and is divided into three ſmooth planes, fitted to the three oſſa cuneiformia.

The os naviculare and aſtragalus are joined as a ball and ſocket, and the naviculare moves in all directions in turning the toes inwards, or in raiſing or depreſſing either ſide of the foot, though the motions are greatly reſtrained by the ligaments which connect this to the other bones of the tarſus.

Os cuboides is a very irregular cube.——Behind, it is formed into an oblong unequal concavity, adapted to the fore-part of the os calcis.—On its internal ſide, there is a ſmall ſemicircular ſmooth cavity, to join the os naviculare.—Immediately before which, an oblong ſmooth plane is made by the os cuneiforme externum.——Below this, the bone is hollow and rough.—On the internal ſide of the lower ſurface, a round protuberance and foſſa are found, where the muſculus adductor pollicis has its origin. On the external ſide of this ſame ſurface, there is a round knob, covered with cartilage; immediately before which, a ſmooth foſſa may be obſerved, in which the tendon of the peronæus primus runs obliquely croſs

the

the foot; and on the knob, the thin flat cartilage proper to this muſcle plays; in place of which, ſometimes a bone is found:—More externally than the knob, a rough hollow is made, for the ſtrong ligaments ſtretched betwixt this bone and the os calcis.—Before, the ſurface of the os cuboides is flat, ſmooth, and ſlightly divided into two planes, for ſuſtaining the os metatarſi of the little toe, and of the toe next to it.

The form of the back-part of the os cuboides, and the ligaments connecting the joint there with the os calcis, both concur in allowing little motion in this part.

Os cuneiforme externum, is much of the ſhape of a wedge, being broad and flat above, with long ſides running obliquely downwards, and terminating in a ſharp edge.—The upper ſurface of this bone is an oblong ſquare.—The one behind is nearly a triangle, but not complete at the inferior angle, and is joined to the os naviculare.—The external ſide is an oblong ſquare, divided as it were by a diagonal: The upper half of it is ſmooth, for its conjunction with the os cuboides: The other is a ſcabrous hollow; and in its ſuperior anterior angle, a ſmall ſmooth impreſſion is made by the os metatarſi of the toe next to the little one.—The internal ſide of this bone is alſo quadrangular, with the fore-part of its edge made flat and ſmooth by the os metatarſi of the toe next to the great one; and the back-part is alſo flat and ſmooth, where the os cuneiforme medium is contiguous to it.—The fore-part of this bone is an oblong triangle, for ſuſtaining the os metatarſi of the middle toe.

Os cuneiforme medium, or minimum, is ſtill more exactly the ſhape of a wedge than the former.——Its upper part is ſquare;—its internal ſide has a flat ſmooth ſurface above and behind, for its conjunction with the following bone; with a ſmall rough foſſa below; and a conſiderable ſhare of it is rough and hollow.—The external ſide is ſmooth and a little hollowed, where it is contiguous to the laſt deſcribed bone.—Behind, this bone is triangular, where it is articulated with the os naviculare; and it is alſo triangular at its fore-part, where it is contiguous to the os metatarſi of the toe next to the great one.

Os cuneiforme maximum, or internum, differs from the two former in its ſituation, which is more oblique than theirs.—Beſides, its broad thick part is placed below, and the ſmall thin point is above and outwards; while its under broad ſurface is concave, for allowing a ſafe paſſage to the flexors of the great toe.—The ſurface of this os cuneiforme behind, where it is joined to the os naviculare, is hollow, ſmooth, and of a circular figure below, but pointed above.—The external ſide conſiſts of two ſmooth and flat ſurfaces, whoſe direction is nearly at right angles with each other. With the poſterior, that runs obliquely from below forwards and upwards, the os cuneiforme minimum is joined; and with the anterior, whoſe direction is longitudinal, the os metatarſi of the toe next to the great one is connected.—The fore-part of this bone is ſemilunar, but flat and ſmooth, for ſuſtaining the os metatarſi of the great toe.—The internal ſide is ſcabrous, with two remarkable tubercles below, from which the muſculus abductor pollicis riſes, and the tibialis anticus is inſerted into its upper part.

The three cuneiform bones are all ſo ſecured by ligaments, that very little motion is allowed in any of them.

Theſe ſeven bones of the tarſus, when joined, are convex above, and leave a concavity below, for lodging ſafely the ſeveral muſcles, tendons, veſſels, and nerves that lie in the ſole of the foot.—In the recent ſubject, their upper and lower ſurfaces are covered with ſtrong ligaments, which adhere firmly to them; and all the bones are ſo tightly connected, by theſe and the other ligaments, which are fixed to the rough ridges and foſſæ formerly mentioned, that, notwithſtanding the many ſurfaces covered with cartilage, ſome of which are of the form of the very moveable articulations, no more motion is here allowed, than only to prevent too great a ſhock of the fabric of the body in walking, leaping, *&c.* by falling on too ſolid a baſe.

METATARSUS is compoſed of five bones, which, in their general characters, agree with the metacarpal bones; but may be diſtinguiſhed from them by the following marks: 1. They are longer, thicker, and ſtronger. 2. Their anterior round ends are not ſo broad, and are leſs in proportion to their baſes. 3. Their bodies are ſharper above and flatter on the ſides, with their inferior ridge inclined more to the outſide. 4. The tubercles at the lower parts of the round head are larger.

The firſt or internal metatarſal bone is eaſily diſtinguiſhed from the reſt by its thickneſs.—The one next to it is the longeſt, and with its ſharp edge almoſt perpendicular.——The others are ſhorter and more oblique, as their ſituation is more external.

Os metatarſi pollicis is by far the thickeſt and ſtrongeſt, as having much the greateſt weight to ſuſtain. Its baſe is oblong, irregularly concave, and of a ſemilunar figure, to be adapted to the os cuneiforme maximum.—The inferior edge of this baſe is a little prominent and rough, where the tendon of the peronæus primus muſcle is inſerted.——On its outſide, an oblique circular depreſſion is made by the ſecond metatarſal bone.——Its round head has generally on its fore-part a middle ridge, and two oblong cavities, for the oſſa ſeſamoidea; and on the external ſide, a depreſſion is made by the following bone.

Os metatarſi of the ſecond toe, is the longeſt of the five, with a triangular baſe ſupported by the os cuneiforme medium and the external ſide produced into a proceſs; the end of which is an oblique ſmooth plane, joined to the os cuneiforme externum.——Near the internal edge of the baſe, this bone has two ſmall depreſſions, made by the os cuneiforme maximum, between which is a rough cavity.—Farther forwards, we may obſerve a ſmooth protuberance, which is joined to the foregoing bone.——On the outſide of the baſe are two oblong ſmooth ſurfaces, for its articulation with the following bone; the ſuperior ſmooth ſurface being extended longitudinally, and the inferior perpendicularly; between which there is a rough foſſa.

Os metatarſi of the middle toe, is the ſecond in length.—Its baſe, ſupported by the os cuneiforme externum, is triangular, but ſlanting outwards, where it ends in a ſharp-pointed little proceſs; and the angle below is not completed.

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The internal ſide of this baſe is adapted to the preceding bone; and the external ſide has alſo two ſmooth ſurfaces covered with cartilage, but of a different figure; for the upper one is concave, and, being round behind, turns ſmaller as it advances forewards; and the lower ſurface is little, ſmooth, convex, and very near the edge of the baſe.

Os metatarſi of the fourth toe, is near as long as the former, with a triangular ſlanting baſe, joined to the os cuboides, and made round at its external angle, having one hollow ſmooth ſurface on the outſide, where it is preſſed upon by the following bone, and two on the internal ſide, correſponding to the former bone; behind which is a long narrow ſurface impreſſed by the os cuneiforme externum.

Os metatarſi of the little toe, is the ſhorteſt, ſituated with its two flat ſides above and below, and with the ridges laterally.——The baſe of it, part of which reſts on the os cuboides, is very large, tuberous, and produced into a long-pointed proceſs externally, where part of the abductor minimi digiti is fixed; and into its upper part the peronæus ſecundus is inſerted.——Its inſide has a flat conoidal ſurface, where it is contiguous to the preceding bone.

When we ſtand, the fore-ends of theſe metatarſal bones, and the os calcis, are our only ſupporters; and therefore it is neceſſary they ſhould be ſtrong, and ſhould have a confined motion.

The bones of the Toes are much akin to thoſe of the thumb and fingers; particularly the two of the great toe are preciſely formed as the two laſt of the thumb; only their poſition, in reſpect of the other toes, is not oblique; and they are proportionally much ſtronger, becauſe they are ſubjected to a greater force; for they ſuſtain the force with which our bodies are puſhed forwards by the foot behind at every ſtep we make; and on them principally the weight of the body is ſupported, when we are raiſed on our tiptoes.

The three bones in each of the other four toes, compared to thoſe of the fingers, differ from them in theſe particulars.——They are leſs, and ſmaller in proportion to their lengths:—Their baſes are much larger than their anterior ends: Their bodies are more narrow above and below, and flatter on the ſides.—The firſt phalanx is proportionally much longer than the bones of the ſecond and third, which are very ſhort.

Of the four, the toe next to the great one has the largeſt bones in all dimenſions, and more externally the toes are leſs.—The little toe, and frequently that next to it, have the ſecond and third bones intimately united into one; which may be owing to their little motion, and the great preſſure they are ſubjected to.

The toes are of good uſe to us in walking; for, when the ſole is raiſed, they bring our body, with its centre of gravity, perpendicular to the advanced foot.

The only bones now remaining to complete the deſcription of the ſkeleton, are the ſmall ones, which are found at the joints of the fingers and toes, and in ſome other parts, called

Ossa Sesamoidea, which are of very different figures and ſizes, though they are generally ſaid to reſemble the ſeed of the ſeſamum.——They ſeem to be nothing elſe than the ligaments of the articulations, or the firm tendons of ſtrong muſcles, or both, become bony, by the compreſſion which they ſuffer. Thus the ſeſamoid bones at the beginning of the gaſtrocnemii muſcles, are evidently compoſed of the tendinous fibres only.—Theſe, at the firſt joint of the great toe, are as plainly the ſame continued ſubſtance with the ligaments and the tendons of the adductor, flexor, brevis, and abductor.—That which is ſometimes double at the ſecond joint of that toe, is part of the capſular ligament; and if we enumerate the other ſeſamoid bones that are at any time found, we may obſerve all of them formed in this manner.——Their number, figure, ſituation, and magnitude, are ſo uncertain, that it were in vain to inſiſt on the differences of each; and therefore we ſhall only in general remark,

1. That where-ever the tendons and ligaments are firmeſt, the actions of the muſcles ſtrongeſt, and the compreſſion greateſt, there ſuch bones are moſt commonly found.

2. That, *cæteris paribus*, the older the ſubject is in which they are ſought, their number is greater, and their ſize is larger.

3. The more labour any perſon is inured to, he has, *cæteris paribus*, the moſt numerous and largeſt oſſa ſeſamoidea.

EXPLANATION of PLATE XIII.

Figure I. A Male Skeleton.

A, Os frontis. B, Os parietale. C, Os temporum. D, Os occipitis. E, Oſſa naſi. F, Os malæ. G, Os maxillare ſuperius. H, Os maxillare inferius. I, The teeth, which are ſixteen in each jaw. K, The ſeven vertebræ of the neck, with their intermediate cartilages. L, *&c.* The twelve dorſal vertebræ, with their intermediate cartilages. M, The five lumbar vertebræ, and, N, Their intermediate cartilages. O, Os ſacrum. P, Os coccygis. Q, Os ilium. R, Os pubis. S, Os iſchium. T, The ſeven true ribs. U, The five falſe ribs. V, The ſternum. X, The clavicle. Y, The ſcapula. Z, The os humeri. a, Ulna. b, Radius. c, The eight bones of the carpus. d, The five metacarpal bones. e, The phalanges of the fingers. f, The os femoris. g, The patella. h, The tibia. i, The fibula. k, The ſeven bones of the tarſus. l, The five metatarſal bones. m, The phalanges of the toes.

Fig.

Fig. 2. The internal view of the Os Frontis.

a, The superior serrated edge, which assists to form the coronal suture. b, The external angular process. c, The internal angular process. d, The nasal process. e, The orbitar process. f, The frontal sinus. g, The sagittal suture, which (as here) is sometimes continued to the nose.

Fig. 3. The internal side of the left Parietal bone.

a, Its superior edge, which, joined with the other, forms the sagittal suture. b, The anterior edge, which assists in the formation of the coronal suture. c, The inferior edge for the squamous suture. d, The posterior edge for the lambdoid suture. e, A depression made by the lateral sinus. f, The prints of the principal artery of the dura mater.

Fig. 4. The internal view of the Occipital bone.

a a, The two sides, which assist to form the lambdoid suture. b, The extremity of the cuneiform process, where it joins the sphenoid bone. c c, The two condyloid processes, which articulate the head with the spine. d d, The prints made by the posterior lobes of the brain. e e, The prints made by the lobes of the cerebellum. f, The cruciform ridge. g, The foramen magnum, through which the spinal marrow passes. h, The foramen linguale, for the passage of the ninth pair of nerves.

Fig. 5. The internal side of the right Temporal bone.

a, The upper edge which forms the squamous suture. b, The pars mammillaris. c, The pars patrosa. d, The zygomatic process. e, The styloid process. f, The entry of the auditory nerve.

Fig. 6. The internal view of the Sphenoid bone.

a a, The temporal processes. b b, The pterygoid processes. c c, The spinous processes. d d, The posterior clinoid processes. e e, The anterior clinoid processes. f, The sella turcica, for lodging the glandula pituitaria. g. The anterior process, which joins the ethmoid bone.

Fig. 7. The exterior view of the Ethmoid bone.

a, The pars plana, which forms part of the orbit. b, The os spongiosum superius. c, The nasal lamella. d, The ethmoid cells. e, Crista galli.

Fig. 8. The posterior view of the Ossa Nasi.

a, Their superior sides. b, Their inferior sides. c, Their exterior sides. d, Their joining.

Fig. 9. The side of the Os Unguis next to the nose.

a, The orbitar part. b, The lachrymal part. c, The furrow between these two convex parts.

Fig. 10. The posterior view of the right Os Malæ.

a, The superior orbitar process. b, The inferior orbitar process. c, The malar process. d, The zygomatic process. e, The internal orbitar process.

Fig. 11. A view of the lower part, and side next to the nose, of the right Os Maxillare, with the Palate-bone, and Os Spongiosum Inferius.

a, The nasal process. b, The tuber, at the top of which is the orbitar process, and within it, k, The antrum maxillare. c, The nasal spine. d, The os spongiosum inferius. e, The palate-plate. f, The os palati. g, The two dentes incisores. h, The dens caninus. i, The five dentes molares.

Fig. 12. The right Palate-Bone.

a, The palate-plate. b, The pterygoid process. c, The nasal lamella. d, The orbitar process.

Fig. 13. A view of the side next to the mouth of the left side of the lower jaw.

a, The substance in the middle of the chin. b, The base. c, The angle. d, The coronoid process. e, The condyloid process. f, The entry of the nerve and blood-vessels. g. The five molares.

Fig. 14. A Tooth cut perpendicularly.

a, The fibres of the enamel. b, The osseous part. c, The entry at the point of the root, to d, The channel for the nerve and blood-vessels.

Fig. 15. A view of the interior surface of the Base of the Skull.

A A A, The two tables of the skull, with the *diploe*. B B, The orbitar processes of the *frontal bone*. C, The crista galli, with the cribriform-plate of the *ethmoid bone* on each side of it. D, The cuneiform process of the *os occipitis*. E, The cruciform ridge. F, The foramen magnum for the passage of the medulla spinalis. G, The zygoma, made by the joining of the zygomatic processes of the ossa temporum and occipitis. H, The pars squamosa of the *os temporum*. I, The pars mammillaris. K, The pars petrosa. L, The temporal process of the *sphenoid bone*. M, The anterior clinoid process of the right side. N, The posterior clinoid process of the right side, and between them, O, The sella turcica. 1. The foramen opticum of the left side. 2. The foramen lacerum. 3. The foramen rotundum.

Fig. 16. The frontal, occipital, sphenoid, and ethmoid bones, being cut perpendicularly through the middle, and the nasal, maxillary, and palate bones separated from each other, the interior view of the left side of the Cranium, and bones of the Upper Jaw, are represented.

A A, The two tables and *diploe* of the frontal and occipital bones. B, The coronal suture. C, The serrated edges of the parietal, for forming the sagittal suture. D, The lambdoid suture. E, The squamous suture.

future. F, The furrows made by the veffels of the dura mater. G, The frontal finus. H, The crifta galli. I, The nafal lamella of the ethmoid bone. K, The temporal procefs of the fphenoid bone. L, The fella turcica. M, The fphenoid finus. N, The vomer. O, The palate-plate of the fuperior maxillary bone; and from it the proceffus alveolaris, which contains the teeth. P, The os nafi. Q, The paffage into the left noftril. 1. The meatus auditorius internus, for the paffage of the auditory nerve. 2. The paffage of the ninth pair of nerves. 3. The foramen incifivum.

FIG. 17. The external furface of the bafe of the CRANIUM and UPPER JAW.

A A, The lambdoid future. B, The fuperior horizontal ridge of the occipital bone, which is oppofite to the cruciform ridge, where the fuperior longitudinal finus divides to form the lateral finufes. C, The perpendicular ridge. D, The inferior horizontal ridge. E, The foramen magnum, for the paffage of the medulla fpinalis. F F, The two condyles. G, The cuneiform procefs. H H, The zygomatic procefs of the *temporal bone*. I I, The maftoid proceffes. K, The vomer, which forms the back-part of the feptum nafi. L L, The ftyloid proceffes. M M, The foffæ at the root of the maftoid proceffes, for the pofterior belly of the digaftric mufcle. N N, The cavities for receiving the condyles of the lower jaw. O O, The offa palati. P, The longitudinal palate-future. Q, The tranfverfe palate-future. R, The alveoli, or fpongy fockets for the teeth. S, The zygomatic procefs of the offa malarum. T T, The zygomatic future. 1. Meatus auditorius externus. 2. Hole for the internal carotid artery. 3. For the artery of the dura mater. 4. Foramen ovale, for the third branch of the fifth pair, to the upper jaw.

EXPLANATION OF PLATE XIV.

FIG. 1. A pofterior view of the STERNUM and CLAVICLES, with the ligament connecting the clavicles to each other.

a, The pofterior furface of the fternum. b b, The broken ends of the cavicles. c c c c, The tubercles near the extremity of each clavicle. d, The ligament connecting the clavicles.

FIG. 2. A fore view of the LEFT SCAPULA, and of a half of the CLAVICLE, with their ligaments.

a, The fpine of the fcapula. b, The acromion. c, The inferior angle. d, Inferior cofta. e, Cervix. f, Glenoid cavity, covered with cartilage for the arm-bone. g g, The capfular ligament of the joint. h, Coracoid procefs. i, The broken end of the clavicle. k, Its extremity joined to the acromion. l, A ligament coming out fingle from the acromion to the coracoid procefs. m, A ligament coming out fingle from the acromion, and dividing into two, which are fixed to the coracoid procefs.

FIG. 3. The joint of the elbow of the LEFT ARM, with the ligaments.

a, The os humeri. b, Its internal condyle. c c, The two prominent parts of its trochlea, appearing through the capfular ligament. d, The ulna. e, The radius. f, The part of the ligament including the head of the radius.

FIG. 4. The BONES of the RIGHT-HAND, with the PALM in view.

a, The radius. b, The ulna. c, The fcaphoid bone of the carpus. d, The os lunare. e, The os cuneiforme. f, The os pififorme. g, Trapezium, h, Trapezoides. i, Capitatum. k, Unciforme. l, The four metacarpal bones of the fingers. m, The firft phalanx. n, The fecond phalanx. o, The third phalanx. p, The metacarpal bone of the thumb. q, The firft joint. r, The fecond joint.

FIG. 5. The pofterior view of the BONES of the LEFT HAND.

The explication of Fig. 4. ferves for this figure; the fame letters pointing the fame bones, though in a different view.

FIG. 6. The upper extremity of the TIBIA, with the femilunar cartilages of the joint of the knee, and fome ligaments.

a, The ftrong ligament which connects the rotula to the tubercle of the tibia. b b, The parts of the extremity of the tibia, covered with cartilage, which appear within the femilunar cartilages. c c, The femilunar cartilages. d, The two parts of what is called the crofs ligament.

FIG. 7. The pofterior view of the joint of the RIGHT KNEE.

a, The os femoris cut. b, Its internal condyle. c, Its external condyle. d, The back-part of the tibia. e, The fuperior extremity of the fibula. f, The edge of the internal femilunar cartilage. g, An oblique ligament. h, A larger perpendicular ligament. i, A ligament connecting the femur and fibula.

FIG. 8. The anterior view of the joint of the RIGHT KNEE.

b, The internal condyle. c, Its external condyle: d, The part of the os femoris, on which the patella moves. e, A perpendicular ligament. f f, The two parts of the crucial ligaments. g g, The edges of the two moveable femilunar cartilages. h, The tibia.

i, The

i, The ſtrong ligament of the patella.—The back-part of it where the fat has been diſſected away. l, The external depreſſion. m, The internal one. n, The cut tibia.

FIG. 9. A view of the inferior part of the bones of the RIGHT FOOT.

a, The great knob of the os calcis. b, A prominence on its outſide. c, The hollow for the tendons, nerves, and blood-veſſels. d, The anterior extremity of the os calcis. e, Part of the aſtragalus. f, Its head covered with cartilage. g, The internal prominence of the os naviculare. h, The os cuboides. i, The os cuneiforme internum; k, —Medium; l, —Externum. m, The metatarſal bones of the four leſſer toes. n, The firſt— o, The ſecond— p, The third phalanx of the four leſſer toes. q, The metatarſal bones of the great toe. r, Its firſt— s, Its ſecond joint.

FIG. 10. The inferior ſurface of the two large SESAMOID BONES, at the firſt joint of the great toe.

FIG. 11. The ſuperior view of the bones of the RIGHT FOOT.

a, b, as in Fig. 9. c, The ſuperior head of the aſtragalus. d, *&c.* as in Fig. 9.

FIG. 12. The view of the SOLE of the FOOT with its ligaments.

a, The great knob of the os calcis. b, The hollow for the tendons, nerves, and blood-veſſels. c, The ſheaths of the flexores pollicis and digitorum longi opened. d, The ſtrong cartilaginous ligament ſupporting the head of the aſtragalus. e, h, Two ligaments which unite into one, and are fixed to the metatarſal bone of the great toe. f, A ligament from the knob of the os calcis to the metatarſal bone of the little toe. g, A ſtrong triangular ligament, which ſupports the bones of the tarſus. i, The ligaments of the joints of the five metatarſal bones.

FIG. 13. a, The head of the thigh-bone of a child. b, The ligamentum rotundum connecting it to the acetabulum. c, The capſular ligament of the joint with its arteries injected. d, The numerous veſſels of the mucilaginous gland injected.

FIG. 14. The back view of the cartilages of the LARYNX, with the Os HYOIDES.

a, The poſterior part of the baſe of the os hyoides. b b, Its cornua. c, The appendix of the right ſide. d, A ligament ſent out from the appendix of the left ſide, to the ſtyloid proceſs of the temporal bone. e, The union of the baſe with the left cornu. f f, The poſterior ſides of (g) the thyroid cartilage. h h, Its ſuperior cornua. i i, Its inferior cornua. k, The cricoid cartilage. l l, The arytenoid cartilages. m, The entry into the lungs, named *glottis*. n, The epiglottis. o o, The ſuperior cartilages of the trachea. p, Its ligamentous back-part.

FIG. 15. The ſuperior concave ſurface of the SESAMOID BONES at the firſt joint of the great toe, with their ligaments.

a, Three ſeſamoid bones. b, The ligamentous ſubſtance in which they are formed.

P A R T II.

O F T H E M U S C L E S.

SECT. I. *Of the* MUSCLES *in general.*

THE muſcles are bundles of fibres of different figures and ſizes, and for the moſt part conſiſting of two different portions; one whereof is thick, ſoft, and more or leſs red, forming what is called the body, fleſhy ſubſtance, or belly of the muſcle. The other is thin and ſmall, of a cloſe contexture, and very white, forming the extremities, termed by anatomiſts *tendons* or *aponeuroſes*. Both portions are covered by a particular membrane.

The fibres are, for the moſt part, ranked in faſciculi, in a lateral ſituation with reſpect to each other, and diſtinguiſhed by membranous, cellular, or adipoſe ſepta, as by ſo many particular vaginæ.

Theſe fibres are connected to each other, and to the intermediate ſepta, by a great number of very ſmall fine filaments, the capillary extremities of arteries, veins, and nerves running over them; and they are incloſed in a thin membranous, cellular covering, called the proper membrane of the muſcle, being a continuation of the ſepta or vaginæ already mentioned.

The diſpoſition of the fibres is various: ſome are diſpoſed like radii; others form planes more or leſs incurvated; and ſome form complete circumferences, the two extremities meeting and uniting together.

The difference of muſcles is very conſiderable, and depends on many circumſtances; the chief of which are, the ſize, figure, direction, ſituation, ſtructure, connection, and uſe; and it is from theſe differences that the names of the greateſt part of the muſcles are taken. From

From their ſize they are termed *great, middle, ſmall, long, broad, thin*: From their figure, *triangular, ſcalenous, ſquare*, &c. From their direction, *ſtrait, oblique, tranſverſe*. From their ſituation, *ſuperior, inferior, external*, &c.

With reſpect to their ſtructure, muſcles are either ſimple or compound. Simple muſcles are thoſe whoſe fleſhy fibres, or rather the fleſhy portions of their moving fibres, are all uniformly diſpoſed, and terminate in tendons lying either in a ſtrait or oblique line.

Compound muſcles are thoſe whoſe fleſhy fibres are diſpoſed obliquely in ſeveral particular ranks, repreſenting the ſame number of ſimple muſcles, with their fibres, lying in oppoſite directions. In proportion to the number of theſe ranks or ſeries, the muſcle is ſaid to be more or leſs compounded.

When the compound muſcle is made up of two ſimple muſcles only, theſe are ſo diſpoſed as to repreſent a feather, and the compound muſcle is from thence termed *penniform*.

Some are made up of two muſcles more or leſs, in a lateral ſituation with reſpect to each other, and united at one extremity: others are made up of three or four muſcles, ſituated in the ſame manner; and if they are united at that extremity which the ancients called the head of the muſcle, they are called *bicipites, tricipites*, &c. according to the number of theſe heads; but if they are joined at the other extremity, they are termed *bicornes, tricornes*, &c.

The muſcles are fixed by their extremities to different parts, and in different places of the human body. The greateſt part of them are inſerted in bones alone. Some are fixed partly to bones, and partly to cartilages; as thoſe of the ear and noſe: ſome partly to bones, and partly to the integuments; as ſeveral muſcles of the face.

The names taken from the connections and inſertions of muſcles are generally of two kinds; one common, and referred to ſome conſiderable part of the body; as when we ſay, the muſcles of the head, of the thorax, abdomen, *&c.*; the other proper, ſpecifying more particularly the inſertions of each muſcle, as the maſtoideus, ſterno-maſtoideus, *&c.*

The general uſe of the muſcles is to move all the parts of the body, whether hard, ſoft, or fluid. Moſt of the hard and ſoft parts are moved by theſe powers being fixed to them, and they move the reſt without any ſuch inſertion.

The action of the muſcles in general, conſiſts chiefly in the contraction or ſhortening of their fleſhy portion; by which the extremities of the muſcle are brought nearer to each other, and conſequently the parts are moved to which theſe extremities are fixed.

The principal phænomena of muſcular action are theſe: The fleſhy portion appears harder and more ſwelled in the time of action than of inaction, as may be readily perceived by touching it in both ſtates: The hardneſs of this ſwelling increaſes in proportion as the motion is continued, as is likewiſe evident by the touch; and it likewiſe increaſes by merely adding to the weight or reſiſtance of the part moved, though its ſituation does not continue to be changed.

Sect. II. *The* Muscles *of the Abdomen.*

By the muſcles of the abdomen, or lower belly, we mean thoſe which form principally the ſides or circumference of that cavity. They are commonly ten in number, five on each ſide; eight whereof are very large, the other two very ſmall.

OBLIQUUS EXTERNUS.

The obliquus externus is a broad thin muſcle, fleſhy on its upper and back-part, and tendinous on the anterior and greateſt portion of the lower part. It reaches from half the lateral and inferior part of the thorax, to almoſt half the lateral and ſuperior part of the pelvis; and from the back-part of the regio lumbaris to the linea alba.

It is fixed, by its upper part, to the ribs; by the lower, to the os ilium, ligamentum Fallopii, and os pubis; and, by the fore-part, to the linea alba. The poſterior portion next the vertebræ of the loins has commonly no true muſcular inſertions.

OBLIQUUS INTERNUS.

The internal oblique is a broad thin muſcle like the former, having nearly the ſame extent and inſertions; that is, in the lower ribs above; in the criſta of the os ilium and ligamentum Fallopii, below; and in the linea alba, before: but it differs from it in this, that its lower part is more fleſhy than the upper.

One portion of its lower extremity, which is entirely fleſhy, is fixed, by very ſhort tendinous fibres, in the middle ſpace between the two labia of the criſta oſſis ilium, from the back-part of the tuberoſity of that criſta, near the ſymphyſis of the os ſacrum, almoſt all the way to the ſuperior and anterior ſpine of the os ilium; ſo that its inſertion reaches farther back than that of the external oblique.

The fleſhy fibres thus fixed, run up firſt a little obliquely from behind forward, and then this obliquity increaſes proportionably as the fibres lie more anteriorly, and they croſs thoſe of the fleſhy portion of the external oblique, being afterwards inſerted exteriorly in the lower edges of the cartilages of all the falſe ribs, and thoſe of the two loweſt true ribs, reaching to the extremity of the cartilago enſiformis.

This muſcle is likewiſe called *obliquus deſcendens*, for the ſame reaſon that the former is termed *aſcendens, obliquus inferior*, and *obliquus minor*, becauſe it does not reach ſo high, and is not quite ſo large as the external oblique.

MUSCULI RECTI.

The recti are long narrow muſcles, thicker than the obliqui. They lie near each other like two large bands, from the lower part of the thorax, to the os pubis, the linea alba coming between them. Their breadth diminiſhes, and their thickneſs increaſes gradually from above downward.

The

A. Bell Sculp.

The ſuperior extremity of each muſcle is fixed to a part of the lower extremity of the ſternum, to the three loweſt true ribs, and to the firſt falſe rib, by the ſame number of digitations, of which that which is fartheſt from the ſternum is the broadeſt.

The body of the muſcle lies in the vagina, formed by the aponeuroſis of the broad muſcles of the abdomen. Exteriorly, it is divided into ſeveral portions, reſembling diſtinct muſcles placed endways, by tranſverſe tendons, termed *enervations*, which commonly are all above the umbilicus, very ſeldom below it, and they adhere very cloſe to the vagina.

The lower extremity of this muſcle is narrower than the upper, and ends in a thin tendon fixed in the internal labium of the upper edge of the os pubis, near the ſymphyſis, and there it touches the tendon of the other rectus.

MUSCULI PYRAMIDALES.

At the lower part of the recti, we meet commonly with two ſmall muſcles, which at firſt ſeem to be a portion or appendix of the former. They are named *pyramidales* from their figure; and by Fallopius, *ſuccenturiati.*

At the lower extremity, they are broad and thick, being there fixed to the upper edge of the oſſa pubis, immediately before the recti. They decreaſe gradually in breadth and thickneſs as they aſcend, and end by a point in the linea alba, a little way below the umbilicus.

TRANSVERSALES.

The tranſverſe muſcles are nearly of the ſame breadth with the obliques. Each of them is fixed to the ribs above; below, to the os ilium, and ligamentum Fallopii; before, to the linea alba; and behind, to the vertebræ.

The upper part of this muſcle is fixed to the lower part of the inner ſurface of the cartilages of the two loweſt true ribs, and of all the five falſe ribs, by fleſhy digitations, the fibres of which run more or leſs tranſverſely toward the linea alba, at ſome diſtance from which they become tendinous.

The middle part is fixed to the three firſt vertebræ of the loins, by a double aponeuroſis, or two tendinous planes, one internal or anterior, the other external or poſterior.

The inferior part of this muſcle is fixed by an inſertion wholly fleſhy to the internal labium of the criſta oſſis ilium, and to a great part of the ligamentum Fallopii. From thence many of its fibres run towards the linea alba, the reſt to the os pubis, all of them becoming more or leſs tendinous before their inſertion.

USES OF THE ABDOMINAL MUSCLES.

The common uſes are, to ſuſtain the viſcera of the abdomen, and to counterbalance the perpetual motions of ordinary reſpiration, and thereby gently and continually to act on the viſcera; which action may be reckoned a ſort of trituration, of great importance to the animal œconomy. They compreſs the abdomen, in order to clear it of what ought to paſs off by the natural outlets; to relieve the ſtomach, by vomiting, from whatever might be hurtful to it; and, laſtly, to drive out, by a violent expiration, whatever may incommode the organs contained in the thorax.

The muſculi recti ſerve to ſupport the trunk of the body when inclined backward, and to bend or bring it forward again; to raiſe the body up when lying; and, laſtly, to climb.

The pyramidales ſeem only to aſſiſt the action of the recti; though, when we conſider the oblique direction of their fibres toward the linea alba, there may be ſome reaſon to think that they compreſs the bladder, eſpecially when very full of urine.

The tranſverſales ſeem to have no other uſe than that of bracing or girding the abdomen in different degrees.

SECT. III. *The* MUSCLES *which move the Bones of the Shoulder upon the Trunk.*

TRAPEZIUS.

The trapezius is a large, broad, thin, fleſhy plane, ſituated between the occiput and lower part of the back, and from thence extending to the ſhoulder, in the figure of a large irregular ſquare. From this figure the ancient Greeks took its name, and, together with the trapezius of the other ſide, it forms a kind of lozenge.

Above, it is fixed in the ſuperior tranſverſe line of the os occipitis, by a thin ſeries of fleſhy fibres, reaching to the muſculus occipitalis, and appearing to cover that muſcle by a kind of aponeuroſis. Behind, it is fixed to the five ſuperior ſpinal apophyſes of the neck, by means of the poſterior cervical ligament, and immediately to the extremities of the two loweſt ſpinal apophyſes of the neck, and of all thoſe of the back.

This muſcle covers immediately the ſplenius or maſtoidæus ſuperior, part of the complexus major, the angularis, rhomboides, and part of the latiſſimus dorſi.

RHOMBOIDES.

This muſcle is a thin, broad, and obliquely ſquare fleſhy plane, ſituated between the baſis of the ſcapula and the ſpina dorſi; and it is from its figure that it has been termed *rhomboides*.

It may be divided into two portions, one ſuperior, the other inferior, which ſometimes appear ſeparate. The ſuperior portion is fixed, by an inſertion wholly fleſhy, in the two or three loweſt ſpinal apophyſes of the neck, and partly in the poſterior cervical ligament. The inferior portion is fixed, by a tendinous plane, in the three or four uppermoſt ſpinal apophyſes of the back.

Theſe two portions, of which the inferior is by much the broadeſt, being united, are inſerted in the edge of the baſis ſcapulæ, from the ſmall triangular ſpace to the inferior angle, the ſuperior portion covering a ſmall part of the inſertion of the angularis.

This

This whole muſcle is covered by the trapezius, and covers immediately the ſerratus poſticus ſuperior, being joined to each of theſe muſcles by a filamentary or cellulous ſubſtance.

Angularis, vulgo Levator Scapulæ Proprius.

This is a long, and pretty thick muſcle, about two fingers in breadth, lying above the ſuperior angle of the ſcapula, along the poſterior lateral part of the neck of that bone.

It is inſerted above in the extremities of the tranſverſe apophyſes of the four firſt vertebræ of the neck, by four fleſhy branches, ending in ſhort tendons; ſometimes the ſecond, ſometimes the third, or both, and ſometimes the fourth of theſe branches, is wanting; theſe defects being made up by the largeneſs of the reſt.

From thence theſe branches run down a little obliquely, and then uniting together, they are inſerted in the ſuperior angle of the ſcapula, and in the edge of its baſis, from thence to the ſmall triangular ſpace, being there covered a little by the rhomboides.

This muſcle is eaſily divided into two through its whole length. It is covered by the trapezius, and its inſertions in the neck are ſometimes mixed with thoſe of the neighbouring muſcles.

PECTORALIS MINOR.

This is a ſmall fleſhy muſcle, ſomething of a triangular ſhape, ſituated at the ſuperior, lateral, and anterior part of the thorax.

By its baſis it is inſerted in the external labium of the upper edge of the ſecond, third, fourth, and fifth true ribs; near their union with the cartilages, by the ſame number of digitations or ſeparate fleſhy portions, becauſe of the intervals between the ribs; and for that reaſon it has been called *ſerratus minor anticus*.

From thence theſe portions run up, more or leſs, obliquely toward the ſhoulder, and form a fleſhy belly, which contracts as it paſſes before the two firſt ribs, and then becoming a ſhort, flat, and broad tendon, is inſerted in the upper part of the apophyſis coracoides of the ſcapula, reaching all the way to the point of that proceſs.

This muſcle is covered by the pectoralis major, and adheres very cloſely to the external intercoſtal muſcles.

SERRATUS MAJOR.

This is a broad, fleſhy, and pretty thick muſcle, lying on the lateral part of the thorax, between the ribs and ſcapula, by which it is covered. Its figure is that of an irregular ſquare, its greateſt breadth being in the back-part, where it terminates by digitations of unequal lengths, in a radiated diſpoſition, their extremities deſcribing an arch or curve; and from theſe digitations its name is taken.

It is inſerted backward in the internal labium of all the baſis of the ſcapula, from the ſuperior to the inferior angle. From thence running forward wholly fleſhy, it increaſes gradually in breadth, and is inſerted in all the true ribs, and often in one or two of the falſe ribs, by the ſame number of digitations.

SUBCLAVIUS.

This is a ſmall oblong muſcle, lying between the clavicle and firſt rib. It is fixed by one end in all the middle lower portion of the clavicle, at the diſtance of about an inch from each extremity; and by the other in the cartilage and a ſmall part of the bone of the firſt rib. It ſeems likewiſe to adhere to the extremity of the clavicle next the ſternum, by a kind of broad thin ligament.

Uses *of the* Muscles *which move the* Bones *of the* Shoulder *on the* Trunk.

The mechaniſm of the ſcapula, in relation to its motions and changes of ſituation, is very different from that of all the other bones of the body, except the os hyoides. All the other bones have ſolid fulcra or fixed points, on which they are either moved or fixed by the muſcles; but the motions of the ſcapula, its changes of ſituation, and its continuance in any one given attitude, are brought about without the help of any ſolid fulcrum. The muſcles alone ſuſtain it and brace it down, in all its different motions and ſituations.

The ſcapula has this peculiarity likewiſe belonging to it, that it is the fulcrum and baſis of all the motions of the os humeri, of ſome motions of the fore-arm, and even of all the moſt violent efforts made with theſe bones, without being itſelf either moved or fixed on any ſolid baſis.

The uſe of the trapezius is to raiſe the ſhoulder, and to keep it from ſinking.

The ſerratus major raiſes the ſhoulder or top of the ſcapula, brings it forward, and hinders it from ſinking. In all theſe, it is the principal actor; and it is impoſſible to conceive how labourers raiſe and ſupport, by the ſhoulder alone, the heavy burdens with which they are loaded, without the aſſiſtance of this muſcle.

According to the inſertions and direction of the rhomboides, its general uſe muſt be, to draw backward and upward the ſub-ſpinal portion of the baſis ſcapulæ.

It is likewiſe a moderator to the trapezius and ſerratus major, when they raiſe the ſhoulder, or carry the acromium upward; and it brings the ſcapula back to its natural ſituation, when the action of theſe muſcles ceaſes.

The angularis, by its inſertion in the ſuperior angle of the ſcapula, moderates the deſcent of that angle, while the trapezius and ſerratus major raiſe the acromium. Afterwards, when theſe two muſcles ceaſe to act, the angularis raiſes the ſuperior angle, and by that means depreſſes the acromium.

The pectoralis minor aſſiſts the rhomboides and angularis, as moderators of the action of the trapezius and ſerratus major, in turning the point of the acromium upward, the ſuperior angle downward, and the inferior angle forward.

It is likewiſe an aſſiſtant to the rhomboides and angularis, in reſtoring the ſcapula to its natural ſituation, when

when the trapezius and ſerratus major ceaſe to act; by drawing downward the apophyſis coracoides, in which it is inſerted.

The ſubclavius can have no other ordinary uſe, but to bring down the clavicula, after it has been raiſed, together with the acromium, by the action of the trapezius and ſerratus major.

SECT. IV. *The* MUSCLES *which move the Os Humeri on the Scapula.*

DELTOIDES.

THIS is a very thick muſcle, covering the upper part of the arm, and forming what is termed the ſtump of the ſhoulder. It is broad above, and narrow below, in a triangular form; and its name is taken from the reſemblance it bears to the Greek letter Δ delta.

It is made up of eighteen or twenty ſmall ſingle muſcles, in an oppoſite ſituation with reſpect to each other, and united by middle tendons; ſo that, taken all together, they form ſeveral penniform muſcles. The outer ſurface appears almoſt wholly fleſhy, but on the inner ſurface we ſee the ſeveral tendons.

Above, it is fixed in the whole inferior labium of the ſpina ſcapulæ, in the convex or long edge of the acromium, and in the third part of the anterior edge of the clavicle next that apophyſis. It ſurrounds the angle formed by the articulation of theſe two bones, by a particular ſlope and fold contrived for that purpoſe.

From thence it runs down above one third of the length of the os humeri, where it is inſerted, by a thick tendon, in the large muſcular rough impreſſion below the bony ridge which goes from the great tuberoſity of the head of the bone.

PECTORALIS MAJOR.

THIS is a large, thick, and fleſhy muſcle, covering the fore-part of the breaſt, from the ſternum, where it is very broad, to the axilla, where it contracts in its paſſage to the arm.

The inſertions in the ſternum end by a great number of very ſhort tendons which run toward the middle of the bone, meeting and decuſſating thoſe from the ſame muſcle on the other ſide. The lower inſertions are moſt diſtinctly digitated, and they mix with thoſe belonging to the rectus and obliquus externus of the abdomen, there being likewiſe ſeveral faſciculi of fibres common to the pectoralis with theſe muſcles. This portion is alſo fixed to the ribs by internal fleſhy ſtrata covered by the external inſertions, and forming, together with them, the thickneſs of the muſcle.

From thence all the fleſhy fibres contract in breadth, and approach each other, in their paſſage to the arm. The ſuperior fibres run downward, joining thoſe of the clavicular portion; thoſe next them run leſs obliquely; the following more or leſs tranſverſely; and the inferior run upward, in the ſame manner.

This muſcle, together with the deltoides, ſends off an aponeuroſis, which, joining that of the biceps, is ſpread over the muſcles of the arm.

LATISSIMUS DORSI.

THIS is a broad, thin, and moſtly fleſhy muſcle, lying between the axilla, where it is very narrow, and the back on which it expands itſelf by radiated fibres, both in length and breadth, from the middle of the back all the way to the lower part of the regio lumbaris; and from this ſituation it has its name.

Its inſertions are partly tendinous, and partly fleſhy. In the firſt place, it is ſometimes, but not always, fixed in the inferior coſta of the ſcapula near the angle, by a faſciculus of fleſhy fibres. In the next place, it is fixed by an aponeuroſis, in the ſpinal apophyſes of the ſix or ſeven, and ſometimes eight loweſt vertebræ of the back, in thoſe of all the vertebræ of the loins, in the ſuperior ſpines and lateral parts of the os ſacrum, and in the external labium of the poſterior part of the os ilium.

TERES MAJOR.

THIS is a long, thick, flat muſcle, ſituated a little obliquely between the inferior angle of the ſcapula, and the upper part of the arm.

It is fixed by its poſterior fleſhy extremity in all the large angular ſurface on the outſide of the ſcapula, in the inferior coſta of that bone, and near the angle. From thence it advances with longitudinal fibres toward the upper quarter of the os humeri, terminating in a broad flat tendon intermixed with ſome fleſhy fibres, which at the upper edge are continued all the way to the inſertion, lying in the ſame place with the tendon.

It is inſerted, by its anterior extremity, at the lower part of the bony ridge of the ſmall tuberoſity, along the edge of the channel, almoſt oppoſite to, and ſometimes a little lower than the inſertion of the pectoralis major. It lines the cavity of the channel by a tendinous elongation, which joins that from the pectoralis, and ſeems to be continued with it.

TERES MINOR.

THIS is a very fleſhy muſcle, reſembling the teres major, but narrower and ſhorter. It lies above the laſt named muſcle, between the coſta inferior of the ſcapula, and the head of the os humeri.

It is fixed by one end to all the middle part of the inferior coſta of the ſcapula, and to the long particular ſurface immediately above that coſta, reaching from the great angular ſurface near the neck of the bone. From thence it runs wholly fleſhy, till it changes into a flat tendon, which is inſerted in the poſterior or inferior ſurface of the great tuberoſity of the head of the bone, and likewiſe a little lower down.

INFRA-SPINATUS.

THIS is a triangular, fleſhy, and pretty broad muſcle, in ſome meaſure penniform, filling the whole infra-ſpinal cavity or foſſa of the ſcapula.

It

It is fixed in the poſterior half of the infra-ſpinal cavity or foſſa, and to the correſponding part of the baſis of the ſcapula.

From thence ariſe a great number of ſhort fleſhy fibres, which run more or leſs obliquely, and end in a middle tendinous plane, which terminates a little below the broadeſt part of the ſpine of the ſcapula, under the root of the acromium.

Then the fleſhy fibres, leaving the bone, unite in one fleſhy maſs, which, paſſing under the acromium, over the articulation of the head of the os humeri, and adhering to the capſular ligament, terminates there in a flat broad tendon, which, adhering likewiſe to the capſula, is afterwards inſerted in the greater middle ſurface of the great tuberoſity of the head of the os humeri.

SUPRA-SPINATUS.

This is a thick narrow muſcle, in ſome meaſure penniform, filling all the ſupra-ſpinal cavity of the ſcapula.

It is fixed to all the poſterior half of the ſupra-ſpinal foſſa; and ſometimes its inſertion reaches near the neck of the bone. There the fibres leave the ſurface of the bone, and paſs between the acromium and neck of the ſcapula, under the arch formed by the acromium and extremity of the clavicle, and under the ligament between the acromium and apophyſis coracoides; being afterwards inſerted in the ſuperior ſurface of the great tuberoſity of the head of the os humeri, very near the bony channel.

CORACO-BRACHIALIS.

This is a long muſcle lying on the inſide of the upper half of the os humeri.

It is fixed above to the point of the coracoid apophyſis, between the inſertions of the biceps and pectoralis minor, by a tendon, which, as it deſcends, adheres for a good way to the tendons of theſe two muſcles. Afterwards it becomes fleſhy, and is inſerted by a broad thin extremity, with a ſmall mixture of tendinous fibres, in the middle part of the os humeri.

SUBSCAPULARIS.

This muſcle is of the ſame breadth and length with the ſcapula, of which it occupies all the inner or concave ſide; and from this ſituation it has its name. It is thick, and made up of ſeveral penniform portions nearly in the ſame manner with the deltoides.

It is fixed in the internal labium of the whole baſis, and in almoſt the whole internal ſurface of the ſcapula; its fleſhy portions lying in the intervals between the bony lines, when theſe are found. Near the neck, they leave the bone, and form a very broad tendon which is inſerted in the ſurface of the ſmall tuberoſity of the head of the os humeri.

Uses *of the* Muscles *which move the* Os Humeri *on the* Scapula.

The deltoides, from the diſpoſition of its inſertions in the ſcapula and clavicle, may raiſe the arm, or ſeparate it from the ribs, not only directly, but likewiſe obliquely in many different ways. The arm being lifted directly upward, the lateral, anterior, and poſterior portions of this muſcle may bring the arm, ſo raiſed, forward and backward.

The latiſſimus dorſi ſerves in general to bring down the arm when raiſed; it alſo ſerves to depreſs the ſhoulder, or to maintain it in that ſituation againſt any force that endeavours to raiſe it; as when we lean upon the elbow in ſitting, or walk upon crutches.

The pectoralis major ſerves in general to bring the arm near the ribs, to preſs it ſtrongly againſt them, and to carry it towards the fore-part of the thorax.

The teres major, by being inſerted in the os humeri in a direction parallel to the latiſſimus dorſi, becomes a congener to the ſuperior and poſterior portion of that muſcle; and accordingly moves the os humeri in the ſame manner with it. It turns the bone round its axis, when the fore-arm is carried behind the back.

It likewiſe pulls the arm directly backward, without moving it round its axis.

The coraco-brachialis brings the arm to the foreſide of the thorax, raiſing it at the ſame time; and, in this caſe, it may be reckoned a congener or aſſiſtant to the pectoralis major in great efforts; and may perform the ſame motion by itſelf, when no great force is neceſſary; as when the whole arm hangs down, and is moved backward and forward like a pendulum, the motion forward being performed by the coraco-brachialis, and the motion backward by the teres major, its antagoniſt.

This muſcle may likewiſe move the ſcapula on the os humeri kept firmly depreſſed, as when ſitting in a chair we take faſt hold of the edge of it with the hand. In this caſe the coraco-brachialis may bring the arcromium downward, and the inferior angle of the ſcapula, near the vertebræ. It ſerves likewiſe to bring the arm to its former ſituation, after it has been turned by the latiſſimus dorſi, in order to apply the hand to the back; and then it turns the os humeri upon its axis in a contrary direction to that given it by the other muſcle.

The ſupra-ſpinatus joins with the deltoides in lifting up the arm; this muſcle beginning that action, and the deltoides continuing it.

The infra-ſpinatus being inſerted by its tendon in the middle ſurface of the great tuberoſity of the os humeri, muſt perform different motions according to the different ſituations of that bone. If it acts while the arm hangs down, parallel to the trunk of the body, it may move the os humeri round its axis, from before outward; and conſequently, if the fore-arm be at the ſame time bent, it will turn the hand from the body, *&c.*

When the arm hangs down in its natural ſituation, the ſubſcapularis may turn it round its axis, from without forward, as it happens when in this ſituation we beat the breaſt with the fore-arm bent; and it likewiſe ſtrongly aſſiſts the latiſſimus dorſi, when we turn the hand behind the back.

When the arm being raiſed, we move it backward, as in giving a back-ſtroke with the elbow or fiſt, the ſubſcapularis hinders the head of the os humeri from being luxated forward.

The

The teres minor may turn the arm when depressed round its axis, from before outward; as it happens when the fore-arm, being bent and applied to the lower part of the breast, is removed from thence, without moving the elbow from the side.

SECT. V. *The* MUSCLES *which move the Bones of the Fore-arm on the Os Humeri.*

BICEPS *sive* CORACO-RADIALIS.

THIS is a double muscle made up of two long fleshy bodies, more or less round, lying by the side of each other, on the middle anterior part, and a little toward the inside of the arm. These two bodies are separated above, each of them ending in a small tendon. As they run down they become contiguous, and afterwards closely united by one common broad tendon.

It is fixed by one of the superior tendons, in the apex of the coracoid apophysis of the scapula.

The other superior tendon is smaller and longer than the former, and the fleshy body belonging to it shorter and more compounded. This tendon is lodged in the bony channel of the os humeri, being surrounded by a membranous vagina continued from the capsular ligament, and ending at the fleshy body where it is entirely closed.

BRACHIÆUS.

THIS is an oblong, thick, and broad muscle, lying immediately on the anterior part of the lower half of the os humeri. The upper part of it is forked or sloped, and at the bending of the joint of the elbow the lower part contracts.

It is fixed to the surface of the os humeri by a great number of fleshy fibres, from the lower insertion of the deltoides, almost down to the two fossæ at the lower extremity of the bone, and from one edge of the foreside of this lower extremity to the other: The fibres are for the most part longitudinal, those nearest the surface of the muscle being longest, the more internal growing gradually shorter.

ANCONÆUS MAJOR.

THIS is a long fleshy muscle lying on the backside of the os humeri.

It is fixed above by a short tendon to the inferior impression in the neck of the scapula, and to a small part of the inferior costa of that bone. From thence it passes between the extremities of the subscapularis and teres minor, and, having reached the backside of the lower extremity of the os humeri, it ends obliquely in a strong broad tendon, which, adhering closely in the capsular ligament, is afterwards fixed by a broad insertion in the rough tuberosity on the upper side of the olecranum.

ANCONÆUS EXTERNUS.

THIS is a long muscle lying on the outer part of the backside of the os humeri, from its neck to the external condyle.

It is fixed above in the neck of the os humeri under the inferior surface of the great tuberosity, and under the insertion of the teres minor, but a little more backward. It is likewise fixed by some oblique fibres in the external inter-muscular ligament.

ANCONÆUS INTERNUS.

THIS muscle is shorter and more fleshy than the anconæus externus, and lies toward the inner part of the lower half of the os humeri.

It is fixed above, under the lower extremity of the teres major, but a little more backward, and to the internal inter-muscular ligament, which makes a kind of septum between this muscle and the brachiæus. From thence the fibres contracting in breadth, pass toward the tendon of the anconæus major, some of them running in between it and the bone, and are inserted in the edge and inner side of that tendon.

ANCONÆUS MINOR.

THIS is a small muscle obliquely triangular, lying in the oblong fossula on the outside of the olecranum.

It is fixed by a small, but pretty strong tendon, in the lower part of the external condyle of the os humeri. From thence the fleshy fibres run down obliquely in a radiated form, and are inserted in the bottom and whole posterior edge of the fossula already mentioned.

USES *of the Muscles which move the Bones of the Fore-arm on the Os Humeri.*

THE biceps, or coraco-radialis, bends both bones of the fore-arm, and turns the radius upon the ulna; performing both motions by its insertion in the radius alone. It likewise moves the os humeri on the fore-arm, the scapula on the os humeri, and the os humeri on the scapula.

The brachiæus serves to bend the fore-arm on the os humeri, by its insertion in the ulna, and by the connection of that bone with the radius. It serves also to move the os humeri on the fore-arm.

The anconæus maximus serves to extend the fore-arm, by bringing the ulna to a straight line with the os humeri. It serves likewise to extend the os humeri on the ulna, when the last named bone is fixed by some exterior resistance, as when, being laid upon the ground, we rise by supporting ourselves on our hand. In this case likewise, the scapula must be kept steady by the coraco-brachialis.

The two lateral anconæi co-operate with, and assist the anconæus maximus, in extending the fore-arm on the os humeri, and the os humeri on the fore-arm.

The anconæus minimus may concur with the other muscles of that name, in extending the fore-arm on the os humeri, and the os humeri on the fore-arm; but its action does not reach to all the degrees of flection of these bones; for when the fore-arm is very much bent, if we examine

examine carefully the situation of this muscle, we will find it more disposed to maintain these bones in that posture, by co-operating with the brachialis, than to extend them by assisting the other anconæi.

Sect. VI. *The* Muscles *which move the Radius upon the Ulna.*

SUPINATOR LONGUS *sive* MAJOR.

This is a long flat muscle, lying on the external condyle of the os humeri, and on the convex side of the radius from one end to the other.

It is fixed by fleshy fibres to the external inter-muscular ligament, and to the crista of the external condyle of the os humeri, for five or six fingers breadth above the condyle, between the brachiæus and anconæus externus. From thence it runs along the whole convex side of the radius, and is inserted by a flat narrow tendon, a little above the styloid apophysis in the angle between the concave and flat sides of the extremity of this bone.

SUPINATOR BREVIS *sive* MINOR.

This is a small thin fleshy muscle, surrounding a great portion of the upper third part of the radius.

It is fixed by one end to the lower part of the external condyle of the os humeri, to the external lateral ligament of the joint, to the annular ligament of the radius, and to part of the lateral eminence in the head of the ulna.

From thence it passes obliquely over the head of the radius, covering some part of it; and running down upon, and in some measure surrounding the neck, it turns in under the bicipital tuberosity, and is inserted by the side of the interosseous ligament in the inside of the superior quarter of the bone, and even a little lower.

PRONATOR TERES *sive* OBLIQUUS.

This is a small muscle, broader than it is thick, situated on the upper part of the ulna opposite to the supinator brevis.

It is fixed to the internal condyle of the os humeri, partly by fleshy fibres, and partly by a tendon common to it with the ulnaris internus. From thence it passes obliquely before the extremity of the tendon of the brachiæus, and reaches to the middle part of the convex side of the radius, where it becomes flat, and is inserted below the supinator brevis by an extremity almost wholly fleshy.

Pronator Quadratus *sive* Transversus.

This is a small fleshy muscle nearly as broad as it is long, lying transversely on the inside of the lower extremity of the fore-arm.

It is fixed by one side or edge in the long eminence at the lower part of the internal angle of the ulna, and by the other in the broad concave side of the lower extremity of the radius.

It has a ligamentary or tendinous frænum belonging to it, one end of which is fixed in the interosseous ligament, the other in the inner edge of the basis of the radius.

The Uses *of the Muscles which move the Radius on the Ulna.*

The supinator longus assists in the motion of supination, and is also a flexor of the fore-arm.

The supinator brevis seems to have no other use than what is expressed by its name; and as it is a short small muscle, it must be very weak.

The pronator teres can have no other action but that of pronation, in the different situations of the radius, whether that bone be in a middle state between pronation and supination, or in the greatest degree of supination; and, in this case, though it is but a small weak muscle, it overcomes the supinator longus.

The pronator quadratus is capable of no other motion but pronation, and it acts with much more force than its congener the pronator teres.

Sect. VII. *The* Muscles *which move the Carpus upon the Fore-arm.*

ULNARIS.

This is a long muscle, fleshy at its upper extremity, and tendinous at the other, situated on the outer part of the ulna.

It is fixed by its upper part in the backside of the long or internal condyle of the os humeri, in that part of the olecranum which is next the condyle, along the upper half of the ulna very nearly; and to the middle common tendon of the neighbouring muscle, termed commonly *profundus*.

It runs in the direction of the external angle of the ulna, and ends by a long tendon, in the os pisiforme or orbiculare of the carpus, reaching likewise to the os unciforme, being united to the ligament common to these two bones.

RADIALIS INTERNUS.

This is a long muscle very like the foregoing, but situated more obliquely.

Its fleshy portion is fixed, by a short tendon, to the outer and upper side of the inner condyle of the os humeri. From thence it passes obliquely toward the radius; and running along about two thirds of that bone, it forms a long tendon, which passes under a particular annular ligament, and under the insertion of the musculus thenar.

This tendon is at length inserted chiefly in the inside of the basis of the first metacarpal bone, and often in the second likewise, and a little in the first phalanx of the thumb, having first passed through the channel of the os trapezium, which sustains the thumb.

ULNARIS.

ULNARIS EXTERNUS.

This is a long muſcle lying on the outſide of the fore-arm, fleſhy toward the os humeri, and tendinous toward the carpus.

It is fixed above to the external condyle of the os humeri, being there united to the anconæus minor, to the annular ligament of the head of the radius, and to the upper half of the external angle of the ulna. From thence it advances, and forms a tendon, which paſſes through the external notch at the lower extremity of this bone, on one ſide of the ſtyloid apophyſis.

The tendon, having afterward paſſed under a particular ligament ſituated near the os cuneiforme of the carpus, is inſerted in the outſide of the baſis of the fourth metacarpal bone, ſending ſome tendinous filaments to the baſis of the little finger.

Radialis Externus, Primus & Secundus.

These are two muſcles cloſely united together, lying along the external angle of the radius, between the os humeri and the carpus, being fleſhy near the former, and tendinous near the latter.

The firſt is inſerted above, in the criſta of the external condyle of the os humeri, below the inſertion of the ſupinator longus. The ſecond is inſerted in the ſame condyle below the inſertion of the firſt; and in the neighbouring articular ligament. From thence the two fleſhy bodies run down very cloſe together; and having reached the middle of the outſide of the radius, each of them terminates in a long tendon.

The two tendons accompany each other to the extremity of the radius; and, having paſſed under a particular annular ligament, they are divided as it were into two cornua; from whence the ancients, who looked upon them as one muſcle, gave it the name of *bicornis*.

One of theſe tendons is inſerted anteriorly in the baſis of the firſt metacarpal bone, the other nearly in the ſame place of the ſecond bone.

Ulnaris Gracilis, *vulgo* Palmaris Longus.

This is a ſmall muſcle, lying between the os humeri and the carpus, on the inſide of the fore-arm; its body being ſmall and ſlender, its tendon very long and flat.

It is fixed by its fleſhy portion, in the ſmall criſta of the inner condyle of the os humeri, ſometimes cloſely united to the ulnaris internus. From thence it runs down fleſhy for ſome ſpace, turning a little obliquely towards the middle of the fore-arm, and ends in a long, narrow, thin tendon.

This tendon paſſes down the middle of the fore-arm, over all the other muſcles to which it ſlightly adheres, and advancing over the large internal annular or tranſverſe ligament of the carpus, is inſerted in the ſurface thereof, ſending off ſome radiated filaments to the aponeuroſis palmaris.

PALMARIS CUTANEUS.

This muſcle is a ſmall thin plane of fleſhy fibres, ſituated tranſverſely, or more or leſs obliquely, under the ſkin of the large eminence in the palm of the hand, between the carpus and the little finger; its fibres adhering to the ſkin, and being in ſome meaſure interwoven with the membrana adipoſa.

Theſe fibres are fixed along the edge of the aponeuroſis palmaris, from the large ligament of the carpus toward the little finger; and they run in for ſome ſpace on the plane of the aponeuroſis, but without any connexion with the bones of the metacarpus. Near the aponeuroſis, theſe fibres are more or leſs tendinous, and ſome of them often croſs each other.

METACARPIUS.

This is a very ſmall fleſhy muſcle, ſituated obliquely between the large internal annular or tranſverſe ligament of the carpus, and the whole inſide of the fourth metacarpal bone.

It is fixed by a ſmall ſhort tendon to the os orbiculare, and to the neighbouring part of the large ligament of the carpus. From thence its fibres run more or leſs obliquely toward the inſide of the fourth metacarpal bone, in the outer edge of which they are inſerted. The fibres of this muſcle are of unequal lengths, and extend all the way to the articulation of the firſt phalanx of the little finger with the fourth metacarpal bone, but they have no manner of relation to that finger.

Uses *of the Muſcles which move the Carpus on the Fore-arm.*

When the ulnarus internus acts alone, or as the principal mover, it brings the hand obliquely toward the internal condyle, and toward the olecranum, though with difficulty.

When it acts together with the radialis internus, it turns the hand equally towards the two extremities of the bones of the fore-arm; and thereby moves not only the carpus in general on the fore-arm, but alſo the ſecond row of the carpus on the firſt, and the metacarpal bones on the ſecond.

When it acts with the ulnaris externus, it turns the outer edge of the hand toward the olecranum.

When the ulnarus externus acts with the ulnaris internus, it turns the outer edge of the hand toward the olecranum, as already ſaid.

With the radiales externi, it turns the back of the hand toward the outer condyle.

When this muſcle acts alone, it brings the outer edge of the hand obliquely toward the olecranum and the external condyle at the ſame time.

With the radialis externus, the internus carries the inner edge of the hand, or that next the thumb, toward the extremity of the radius, and toward the fold made by the ulna and os humeri.

Alone, it moves that part of the hand which is next the thumb obliquely, toward the internal angle of the radius.

The radialis externus, together with the radialis internus, turns the inner edge of the hand directly toward the ſtyloid apophyſis of the radius.

With the ulnaris externus it inverts the hand, turning the convex ſide of the metacarpus toward the lower extremity of the bones of the fore-arm. It likewiſe moves the ſecond row of the carpus on the firſt.

This muſcle, acting alone, draws obliquely, and toward the external angle of the radius, that portion of the hand which anſwers to the firſt metacarpal bone, and to the index.

The ulnaris gracilis, commonly called *palmaris longus*, ſeems to be an aſſiſtant to the ulnaris and radialis interni in bending the wriſt; and it ſeems likewiſe particularly to aſſiſt the radialis internus in the motion of pronation.

The metacarpius ſerves to turn the fourth bone of the metacarpus toward the thumb, and at the ſame time to increaſe the convexity of the back of the hand, which is called making *Diogenes's cup*. The fourth bone thus moved carries the third along with it by reaſon of their connection, which ſtill augments the hollow on one ſide, and the convexity on the other.

SECT. VIII. *The* MUSCLES *which move the Fingers.*

FLEXOR POLLICIS LONGUS.

THIS is a long muſcle, fixed by ſhort and oblique fleſhy fibres to the inſide of the upper part of the interoſſeous ligament, near the radius, and along that bone all the way down to the pronator quadratus. There it terminates in a flat tendon.

This tendon having paſſed under a particular ligament, runs in between the two portions of the thenar, and then into a ſort of groove left between the two ſeſamoide bones fixed to the baſis of the ſecond phalanx of the thumb, on that ſide which is turned to the palm of the hand. Afterwards the tendon ends in the flat ſide of the third phalanx, near its baſis. It is incloſed in a ligamentary vagina, from the annular ligament to its inſertion, and it is divided or ſlit, ſo that it appears to be inſerted by two extremities adhering together by their edges.

EXTENSORES POLLICIS.

THESE are two very diſtinct muſcles, the firſt or longeſt of which is ſometimes more, ſometimes leſs, and ſometimes altogether divided into two, in which caſe theſe muſcles are three in number. They are ſituated obliquely between the ulna and convex ſide of the thumb.

The extenſor primus is a long muſcle, more or leſs double, in the manner already ſaid. It is fixed above by fleſhy fibres, firſt to the outſide of the ulna, near its upper extremity, below the anconæus minor and inſertion of the ulnaris externus; next, to the interoſſeous ligament under the ſupinator brevis; and, laſtly, to the middle part of the outſide of the radius.

From thence it runs down and paſſes anteriorly over the lower part of the radius, and tendons of the ſupinator longus and radialis externus, and being gradually divided, it terminates in two long flat tendons, more or leſs ſubdivided, which paſs together under a particular annular ligament, being only parted by ſepta or fræna belonging to that ligament.

The firſt of theſe two principal tendons is inſerted in the edge of the baſis of the firſt phalanx, near the large tranſverſe ligament of the carpus. When this tendon is ſubdivided, the other portion of it is fixed in that bone of the carpus which ſuſtains the thumb. The other principal tendon, which often belongs to a muſcle entirely diſtinct from the former, is fixed in the convex ſide of the baſis of the ſecond phalanx, where it joins the tendon of the extenſor ſecundus.

The extenſor ſecundus is ſhorter than the firſt. It is fixed to the ulna, below the former, and above the inſertion of the extenſor indicis proprius, and likewiſe to the neighbouring part of the interoſſeous ligament. From thence it runs down obliquely on the middle part of the radius, where it has likewiſe a ſmall adheſion. Afterwards it paſſes through the ſmall channel in the ſtyloid apophyſis of the radius, through the annular ligament belonging to the tendons of the radialis externus, and over theſe tendons, being parted from them by a ſmall ligamentary ſeptum. It is inſerted in the convex part of the third phalanx, near its baſis.

THENAR.

THIS is a very thick fleſhy muſcle, in ſome meaſure pyriform, lying on the firſt phalanx of the thumb toward the palm of the hand, the large eminence in which is chiefly formed by it.

It is fixed to the bone which ſupports the thumb, and to the neighbouring part of the great internal annular ligament of the carpus. It is in ſome meaſure bicipital, two diſtinct portions anſwering to the two inſertions already mentioned. As it runs along the firſt phalanx, theſe two portions unite, and, diminiſhing in thickneſs, are both inſerted by one tendon in the lateral internal part of the head of the firſt phalanx, in the lateral part of the baſis of the ſecond, and in the lateral ligament of that joint.

MESOTHENAR.

THIS is a flat, and nearly triangular muſcle, lying between the firſt phalanx of the thumb, and the bottom of the palm of the hand.

It is inſerted, by a very broad baſis, in the ligament which connects the os magnum of the carpus to that which ſupports the thumb. It is likewiſe inſerted along the internal or angular part of that bone of the metacarpus, which ſupports the middle finger, and in the ſmall extremity of that which anſwers to the index.

From thence the fibres contracting to an angle, terminate in a flat tendon of different breadths, which is inſerted in that ſide of the head of the firſt phalanx of the thumb which is turned to the hollow of the hand, and in the neighbouring part of the baſis of the ſecond phalanx, by means of the ſecond ſeſamoid bone belonging that joint.

ANTITHENAR

ANTITHENAR *five* SEMI-INTEROSSEUS POLLICIS.

THIS is a fmall, flat, flefhy mufcle, fituated obliquely between the firft phalanx of the thumb, and firft bone of the metacarpus.

It is fixed by one end toward the bafis of the firft metacarpal bone, near the firft bone of the fecond row of the carpus. From thence it runs obliquely toward the head of the firft phalanx of the thumb, and is inferted in the lateral external part of that bone, or on that fide which is turned to the firft metacarpal bone. It croffes over the femi-interoffeus indicis, this mufcle lying toward the back of the hand, and the antithenar toward the palm.

PERFORATUS *vulgo* SUBLIMIS.

THIS is a mufcle of a confiderable volume, lying along the infide of the fore-arm, flefhy for the greateft part near the articulation of the fore-arm with the os humeri, and near the carpus, terminating in four diftinct portions, which become the fame number of long fmall tendons. The name of *fublimis* has been given to it, becaufe it lies almoft on the furface of the fore-arm; and that of *perforatus*, from the flits found near the extremities of its tendons.

It is commonly made up of four mufcles, clofely united by their flefhy portions. It is fixed above to the fuperior internal parts of the ulna and radius, and to that of the interoffeus ligament. A little below the middle of the fore-arm, this large flefhy body is divided into four diftinct mufcles, which, on the loweft quarter of the fore-arm, end in four flat tendons of different fizes.

Thefe four tendons are inclofed in a common membranous or mucilaginous vagina, which likewife furnifhes each tendon with a particular thin vagina. In this manner they advance to the carpus, and pafs under the large annular tranfverfe ligament. Beyond this ligament, they fpread again in the palm of the hand, ftill retaining their particular vaginæ, and run between the aponeurofis palmaris and metacarpus, toward the fingers, feparating more and more by degrees.

Having reached the heads of the metacarpal bones, they pafs under the four arches or fræna formed by the furcæ of the aponeurofis palmaris, and particular fepta of the great tranfverfe ligament of the palm of the hand; and then each tendon having got beyond the head of one metacarpal bone, and beyond the bafis of the firft phalanx, enters the ligamentary vagina on the flat or inner fide of that phalanx, and is inferted in the flat fide of the fecond phalanx, near its bafis, the membranous vagina accompanying it to its infertion.

In paffing along the infide of the firft phalanx, the tendon is divided by a long flit, which gives paffage to a tendon of the perforans; and from thence the names of thefe two mufcles are taken.

PERFORANS *vulgo* PROFUNDUS.

THIS mufcle is very like the former, and is fituated much in the fame manner; only it lies lower, and is covered by the perforatus. It is compofed of four mufcles, which at firft feem to make but one mafs, and afterwards terminate in four tendons.

The flefhy portions of the firft and largeft, and alfo of the fecond, are fixed in the fuperior parts of the ulna and interoffeus ligament, down to their middle; the flefhy portion of the third is joined to the tendon of the ulnaris internus, by a fort of common aponeurofis; and that of the fourth is fixed along the ulna.

The four tendons have often feveral fmall collateral tendons, fometimes five in number, united to the tendons of the neighbouring mufcle, as they pafs under the large annular ligament of the carpus; but the tendons themfelves are feparated from the others by thin fepta, which form a kind of particular rings. Being thus ftrengthened, they feparate; and running along the palm of the hand in diftinct membranous vaginæ, like thofe of the perforatus, by which they are covered, they enter the ligamentary vaginæ of the firft phalanges together with the former; and having paffed through the fiffures thereof, and through the ligamentary vaginæ of the fecond phalanges, they are inferted in the flat inner fide of the third, near their bafis.

EXTENSOR DIGITORUM COMMUNIS.

THIS is a compound mufcle, very much refembling the perforatus and perforans, lying on the outfide of the fore-arm, between the ulnaris externus and radialis externus.

It is fixed above, by a tendinous extremity, to the pofterior and lower part of the external or great condyle of the os humeri, and, by a tendinous adhefion on each fide, to the ulnaris and radialis externus. It has likewife fometimes a fmall infertion in the radius. It is divided into four mufcles, like the perforatus and perforans, and four long, flender, fmall tendons.

Three of thefe tendons pafs through the common external annular ligament of the carpus; and the fourth, which goes to the little finger, paffes through a particular ring of the fame ligament.

Afterwards thefe four tendons feparate as they go to the fingers, and in their paffage communicate with each other, by oblique tendinous feries, chiefly near the heads of the metacarpal bones.

Each tendon having reached the bafis of the firft phalanx, is flightly inferted therein by fome lateral expanfions fixed in each fide of the bafis. From thence it advances to the head of the fame phalanx, where it is divided into two flat portions, which, at the articulation of the firft phalanx with the fecond, leave fome diftance between them. About the head of the fecond phalanx, they unite again, and are fixed in the convex fide of the third phalanx, near its bafis.

EXTENSOR INDICIS PROPRIUS.

THIS is a fmall long mufcle, with a long flender tendon, lying a little obliquely on the lower and outer half of the fore-arm, between the ulna and fore-finger.

It is fixed, by its flefhy body, a little higher than the loweft

lowest third part of the outside of the ulna, below the insertion of the extensor pollicis, and it has likewise a small adhesion to the interosseus ligament. From thence it runs down, ending in a distinct tendon, without any communications, which having passed through the annular ligament of the extensor communis, afterwards joins that tendon which goes to the index.

EXTENSOR MINIMI DIGITI PROPRIUS.

This is a kind of collateral or auxiliary muscle of the extensor communis, of which it appears almost always to be more or less a portion.

It is fixed along the superior external half of the ulna, from whence its long small tendon runs down in company with the fourth tendon of the extensor communis, all the way to the little finger, where it joins it, and is inserted with it.

LUMBRICALES.

These are four very small slender muscles, lying in the hollow of the hand, in the same direction with the perforatus and perforans.

They are fixed, by their fleshy bodies, to the tendons of the perforatus on the side next the thumb, near the large annular ligament of the carpus. Near the heads of the metacarpal bones, they become very thin tendons, which accompany those of the perforans through the furcæ of the aponeurosis palmaris. Then they pass on to the same sides of the first phalanges, and join the tendons of the extensor communis; each of them being connected with the nearest portion thereof, at the articulation of the first phalanx with the second.

INTEROSSEI.

These are small muscles, lying between the metacarpal bones, and filling the three interstices left between them, both exteriorly, or towards the back of the hand, and interiorly, or toward the palm of the hand. From this situation they have the name of *interossei*, and have been divided into external and internal. They are commonly reckoned six in number, three external, and three internal.

The first two external interossei are for the most part inserted in the middle finger. They fill the interstices between the three first metacarpal bones, and surround the middle bone all the way to the hollow of the hand. Their tendons are fixed in both sides of the first phalanx, and in both sides of the second tendon of the extensor communis.

The third external interosseus lies in the interstice betwixt the two last metacarpal bones, and is most commonly inserted in the ring finger; its tendon being fixed in that side of the first phalanx farthest from the thumb, and in the corresponding edge of the third tendon of the extensor communis. The fleshy body of this muscle runs in between the two bones toward the hollow of the hand.

The internal interossei are more simple than the former, and do not lie so much between the bones. The tendon of the first is inserted in the side of the first phalanx of the fore-finger, next the little finger, and in the corresponding edge of the extensor communis. The tendon of the second goes in the same manner to the side of the ring-finger next to the thumb; and the third, to the same side of the little finger.

There are therefore two external interossei for the middle finger, one for the ring finger, but none for the fore and little finger. The middle finger has no internal interosseus; but the index, ring finger, and little finger, have each of them one.

SEMI-INTEROSSEUS INDICIS.

This is a small, short, flat, fleshy muscle, very like the antithenar, or internal semi-interosseus of the thumb. It is situated obliquely on one side of that of the thumb, between the first phalanx thereof, and the first metacarpal bone.

It is fixed by one end to the outside of the basis of the first phalanx of the thumb, and a little to that bone of the carpus by which this phalanx is supported; and by the other end it is fixed near the head of the first phalanx of the index, on that side next the thumb.

HYPOTHENAR MINIMI DIGITI.

This is a small and pretty long muscle, lying on the backside of the fourth metacarpal bone opposite to the thumb, where, together with the metacarpius, or hypothenar metacarpi, it forms that large eminence over-against the thenar or that of the thumb.

It is fixed by one end in the os orbiculare of the carpus, and a little to the neighbouring part of the large annular ligament. The other end terminates by a short flattish tendon, fixed to that side of the basis of the first phalanx of the little finger which is turned from the thumb.

Uses *of the Muscles which move the Fingers.*

The perforatus serves to bend the second phalanges of all the fingers except the thumb; and the particular muscles, of which it is made up, may act separately, by reason of their distinct insertions in these phalanges.

They not only bend the second phalanges on the first, but also the first on the metacarpal bones, and the metacarpus and carpus on the fore-arm.

The perforans bends particularly the third phalanges in which it is inserted; and by the same motion it may likewise bend the first and second phalanges.

It may likewise be esteemed an assistant to the ulnaris and radialis interni in great efforts; and these muscles many reciprocally be looked upon as assistants to the perforatus and perforans.

The extensor digitorum communis serves to extend the four fingers, to keep them in any degree of extension, and to moderate their flexion in all the determinate degrees of action of the perforatus and perforans.

Each tendon serves to extend a whole finger, that is, all

all the three phalanges together; and likewiſe each phalanx by itſelf, though not with the ſame facility.

The proper extenſors of the fore and little fingers are aſſiſtants to two ſubaltern muſcles of the extenſor communis that go to theſe fingers, which conſequently we extend ſeparately with more eaſe than either of the other two. Theſe muſcles likewiſe ſerve to bring the fingers, in which they are inſerted, near the other fingers.

The flexor pollicis longus ſerves chiefly to bend the third phalanx of the thumb, in which it is inſerted by the extremity of its tendon. It likewiſe bends the ſecond phalanx, by virtue of the ligamentary vagina, through which it paſſes, as through an annular ligament.

The firſt extenſor of the thumb alone, when there are three, a portion of the firſt, when there are but two, ſerves to draw the firſt phalanx from the palm of the hand, or to keep it at a diſtance therefrom.

The ſecond of theſe muſcles when there are three, or the ſecond portion of the firſt when there are but two, ſerves to extend the ſecond phalanx on the firſt.

The third when there are three, or the ſecond when there are but two, extends the third phalanx on the ſecond.

When they act all together, they aſſiſt each other by the graduated inſertions of their ſmall ſubaltern tendons.

The thenar, by its inſertion in the firſt phalanx of the thumb, ſerves to draw it from the firſt bone of the metacarpus, more or leſs directly, as one of its portions acts more than the other, or as they both act equally.

By the inſertion of the large portion in the baſis of the ſecond phalanx, by the intervention of the ſeſamoid bone of the ſame ſide, it may bend this phalanx laterally on the firſt, and thereby bring the thumb to a greater diſtance from the index.

The meſothenar moves the firſt phalanx of the thumb towards the hollow of the hand, more or leſs obliquely, as it acts either alone or with the large portion of the thenar, or even with the antithenar. By its inſertion in the ſeſamoid bone of the ſecond phalanx, it likewiſe moves that phalanx on the firſt, and thereby aſſiſts the flexor longus.

The antithenar moves the firſt phalanx of the thumb toward the firſt bone of the metacarpus, and thereby preſſes the thumb laterally againſt the index. This motion becomes more or leſs oblique by the co-operation of the meſothenar.

The hypothenar minor ſerves to ſeparate the little finger from the reſt; which motion is commonly called *abduction*. It likewiſe keeps this finger ſeparated in all ſituations, that is, in all degrees of flexion or extenſion.

The interoſſei may have two different uſes, according to their different inſertion, and the different ſituations of the fingers in which they are inſerted.

In general, they aſſiſt the extenſor communis by their inſertions in the lateral angles of the rhomboidal fiſſures; for thereby they act like lateral ropes, which, together with the tendons of the extenſor, ſerve to extend the third phalanx of each finger.

By the ſame lateral inſertions they perform the lateral motions of the fingers, that is, they preſs them all cloſe againſt each other, but do not ſeparate them all, nor move each finger in particular toward, or from, the thumb. In a general ſeparation of all the fingers, the interoſſei move only the middle and ring fingers; the index and little finger being ſeparated by other muſcles. In the motions of the fingers toward the thumb, which is termed *adduction*, they act only on three fingers, the middle, ring, and little fingers. In the contrary motion, or abduction of the fingers, they move likewiſe three, *viz.* the index, middle, and ring fingers.

The uſes of the interoſſei in particular, whether external or internal, may be different in different ſubjects, according to the variety of their inſertions; and therefore in living bodies nothing can be determined about them.

According to the ſituation in which they have been deſcribed, the firſt and ſecond external interoſſei perform alternately the adduction and abduction of the middle finger; the third performs the abduction of the ring-finger; that is, moves it toward the little finger.

The firſt internal interoſſeus makes the abduction of the index, or moves it toward the middle finger; the ſecond makes the adduction of the ring-finger, by moving it likewiſe toward the middle finger; and the third performs the adduction of the little finger, or moves it toward the middle finger.

The uſe of the ſemi-interoſſeus indicis is to move the firſt phalanx of the index, more or leſs directly, toward the great edge of the metacarpus, by removing it from the middle finger. This motion is not a true adduction of the index toward the thumb.

The lumbricales, by the union of their tendons with thoſe of the interoſſei, are coadjutors to theſe muſcles, not only in the lateral motions of the four fingers, but alſo in bending and extending them. In the lateral motions, they co-operate according to their ſituation in each ſubject; and it is poſſible that the variety of their inſertions anſwer to that of the interoſſei, ſo that the reciprocal co-operation continues ſtill to be equal.

Sect. IX. *The* Muscles *which move the Os Femoris upon the Pelvis.*

PSOAS *ſive* LUMBARIS INTERNUS.

This is a long thick muſcle ſituated in the abdomen on the lumbar region, adhering to the vertebræ of the loins, from the poſterior part of the os ilium to the anterior part near the thigh.

It is fixed above to the laſt vetebra of the back, and to all thoſe of the loins, that is, to the lateral parts of the bodies of theſe vertebræ, and to the roots of their tranſverſe apophyſes. The inſertions in the bodies of the vertebræ are by a kind of digitations, and are very little tendinous.

From thence the muſcle runs down laterally over the os ilium, on one ſide of the iliac muſcle, and paſſes under the ligamentum Fallopii, between the anterior inferior ſpine of the os ilium, and that eminence which from its ſituation may be termed *ilio-pectinea*.

Before

Before it goes out of the abdomen, it unites with the iliacus, and is ſometimes fixed, by a few fleſhy fibres, in the outſide of the eminence laſt mentioned. It afterwards covers the fore-ſide of the head of the os femoris, and is inſerted in the fore-part of the little trochanter by an oblique tendon, which is folded double from behind forward.

ILIACUS.

This is a broad thick muſcle, lying on the whole inſide of the os ilium.

It is fixed by fleſhy fibres to the internal labium of the criſta oſſis ilium, to that of the ſlope between the two anterior ſpines, to the inſides of theſe ſpines, to the ſuperior half of the inſide of this bone, and to the neighbouring lateral part of the os ſacrum.

All theſe fibres, contracting by degrees, run obliquely towards the lower part of the muſculus pſoas, uniting therewith, and being fixed by a kind of aponeuroſis to the outſide of its tendon all the way to the little trochanter. They cover the head of the os femoris, and ſome of the loweſt are inſerted in that bone a little above and behind the little trochanter, and others a little lower down.

The iliacus and pſoas, thus united, paſs under the ligamentum Fallopii, over the ſlope or channel, between the anterior inferior ſpine of the os ilium and eminentia ilio-pectinca, in a ſort of ligamentary capſula very ſmooth and poliſhed.

PECTINEUS.

This is a ſmall, flat, and pretty long muſcle, broad at the upper part, and narrow at the lower, ſituated obliquely between the os pubis and upper part of the os femoris.

It is fixed above by fleſhy fibres to all the ſharp ridge or criſta of the os pubis, and to a ſmall part of the oblong notch or depreſſion on the foreſide of that criſta, in which the upper extremity of this muſcle is lodged.

From thence it runs down obliquely towards the little trochanter, under and a little behind which, it is inſerted obliquely by a flat tendon, between the ſuperior inſertion of the vaſtus internus, and inferior inſertion of the triceps ſecundus, with which it is united.

GLUTÆUS MAXIMUS.

This is a thick broad muſcle, lying on the outſide of the os ilium and upper part of the os femoris.

It is fixed wholly fleſhy to all the lateral poſterior parts of the os coccygis and os ſacrum; to the ligamentum ſacro-ſciaticum; to the outſide of the tuberoſity of the os ilium; and from thence to the external labium of the criſta of that bone all the way to its higheſt part, where this muſcle mixes fibres with the glutæus medius.

It is likewiſe fixed to the inſide of the faſcia lata, at the places which anſwer to all the inſertions already mentioned, but through a much greater ſpace, and by a very great number of fleſhy fibres, almoſt in the ſame manner as we ſhall ſee in the external plane of the muſculus temporalis. The fibres which end in this faſcia become gradually ſhorter, as they are ſituated lower.

All theſe fibres contract in breadth in a radiated manner as they approach to the great trochanter, and afterwards form a ſtrong, flat, pretty broad tendon, about an inch in length, which is inſerted a finger's breadth or a little more below the great trochanter, in all that large longitudinal impreſſion at the upper part of the linea aſpera on the back-ſide of the os femoris, between the vaſtus externus and largeſt portion of the triceps.

GLUTÆUS MEDIUS.

This is a radiated muſcle, almoſt in the ſhape of a ſpread fan. It is pretty thick, and almoſt as broad as the whole outſide of the os ilium, being ſituated between the criſta of that bone and the great trochanter, and covered anteriorly by the faſcia lata, and poſteriorly by the glutæus maximus.

It is fixed above by fleſhy fibres to all that ſpace on the outſide of the os ilium, which lies between the external labium of the criſta, and the ſemicircular impreſſion which goes between the ſuperior anterior ſpine, and the great poſterior ſinus.

It is likewiſe fixed in the edge of that ligament which goes between the lower part of the os ſacrum and os ilium. Laſtly, the inner part of it, which is covered only by the faſcia lata, is inſerted in the inſide of that faſcia in the ſame manner as the glutæus maximus.

From thence all the fibres contract in breadth, more or leſs, in a radiated manner, as they advance toward the great trochanter, and form a ſhort thick tendon, which mixes a little anteriorly with the tendon of the glutæus minimus; and the moſt poſterior fibres gradually join the ſide of the tendon of the pyriformis.

The tendon is inſerted in the upper convex part of the great trochanter, from the apex of the large ſuperior external rough ſurface, all the way to the anterior rough ſurface, encompaſſing in a manner all that part of the trochanter.

GLUTÆUS MINIMUS.

This is a ſmall, broad, radiated muſcle, ſituated on the outſide of the os ilium, under the other two glutæi.

It is fixed above in all that portion of the outſide of the os ilium, which lies between the great ſemicircular line, and another ſmall one, a little above the ſupercilium of the cotyloid cavity or acetabulum, running between the anterior inferior ſpine and the great poſterior ſinus. It is likewiſe fixed in the edge of that ſinus, in the ſpine of the iſchium, and in the orbicular ligament of the joint of the hip.

From thence its fibres, contracting in breadth, form a ſhort tendon, by which the muſcle is inſerted in the anterior part of the upper edge of the great trochanter, above the great external convex rough ſurface in which the glutæus medius is fixed.

TRICEPS PRIMUS.

This, with the two following tricipital muſcles, are fleſhy and flat, and of different lengths, ſituated between the os pubis and the whole length of the os femoris. The firſt and ſecond croſs each other in ſuch a manner, as that the muſcle, which is the firſt on the os pubis, becomes the ſecond on the os femoris; and the ſecond on the os pubis, is the firſt on the os femoris. The third muſcle keeps its rank.

The triceps primus is fixed above by a ſhort tendon to the tuberoſity or ſpine of the os pubis, and to the neighbouring part of the ſymphyſis, its fibres mixing a a little with thoſe of the pectineus. From thence it runs down, increaſing in breadth, and is inſerted by fleſhy fibres interiorly in the middle portion of the linea femoris aſpera.

At the lower part of this inſertion, a portion of the muſcle ſeparates from the reſt, and ſends off a long tendon, which, together with a like tendon from the triceps tertius, is inſerted in the inner condyle of the extremity of the os femoris.

TRICEPS SECUNDUS.

This muſcle is fixed above by fleſhy fibres, below the ſuperior inſertion of the triceps primus, in all the outſide of the inferior ramus of the os pubis, as low as the foramen ovale, but ſeldom ſo low as the ramus of the os iſchium.

From thence it runs down, and is inſerted in the upper part of the linea aſpera, between the pectineus and triceps primus, mixing a little with each of theſe muſcles.

TRICEPS TERTIUS.

This muſcle is fixed above by fleſhy fibres to the anterior part of all the ſhort ramus of the iſchium, and to a ſmall part of the tuberoſity of that bone.

From thence it runs down, and is inſerted by fleſhy fibres in the linea aſpera, almoſt from the little trochanter, down to the middle of the os femoris. It goes lower down than the firſt triceps, ſending off a ſeparate portion like that of the muſcle laſt mentioned.

Theſe two portions join together, and form a common tendon, which, running down to the lower extremity of the os femoris, is inſerted in the back part of the tuberoſity of the inner condyle.

PYRIFORMIS *ſive* PYRAMIDALIS.

This is a ſmall oblong muſcle, of the figure of a flat pear or pyramid, from whence it has its name. It is ſituated almoſt tranſverſely, between the os ſacrum and iſchium, being covered and hid by the firſt two glutæi.

It is fixed to the inferior lateral part of the os ſacrum, by fleſhy fibres, and to the neighbouring part of the anterior or concave ſide of that bone, by three digitations lying between the anterior holes. It is likewiſe fixed by a ſmall inſertion to the ligamentum ſacro-ſciaticum and edge of the great ſinus of the os ilium.

From thence it runs tranſverſely towards the joint of the hip, its fibres contracting in breadth, and ends in a ſmall tendon, which is inſerted in the middle of the internal labium of the upper edge of the great trochanter, by two or three branches.

OBTURATOR INTERNUS.

This is a flat muſcle, almoſt triangular, ſituated in the bottom of the pelvis. It covers the foramen ovale, and almoſt all the inſide of the os pubis and iſchium.

It is fixed to the internal labium of all the anterior half of the foramen ovale, a little to the neighbouring part of the obturator ligament; and alſo both above and below the foramen. It is likewiſe fixed to the upper half of the inſide of the os iſchium from the upper oblique notch in the foramen ovale, to the ſuperior part of the great poſterior ſinus of the os ilium.

From all this extent the fleſhy fibres, contracting in breadth, run down below the ſpine of the iſchium, where they go out of the pelvis through the poſterior notch of the iſchium, and afterwards unite in one large flat tendon, which croſſing over that of the pyriformis, unites with it, having firſt received on each ſide ſome additional fleſhy fibres from the two gemelli.

GEMELLI.

These are to two ſmall, flat, narrow muſcles, ſituated almoſt tranſverſely one above the other, between the tuberoſity of the iſchium and the great trochanter, immediately below the pyriformis, and parted by the tendon of the obturator internus.

The ſuperior and ſmalleſt gemellus is fixed to the lower part of the ſpine of the iſchium, to the ſuperior part of the ſmall iſchiatic notch, and to a rough line, which runs croſs the outſide of the iſchium, beginning from the ſpine, and continued under the acetabulum, where it is bent downward.

The inferior and largeſt gemellus is fixed to the ſuperior and back part of the tuberoſity of the iſchium, and to a rough impreſſion which runs croſs the outſide of the iſchium from the lower extremity of the iſchiatic notch, and is bent upward toward the other line, together with which it forms a ſort of irregular ſemicircle.

Both theſe muſcles have likewiſe a ſmall inſertion in the inſide of the iſchium, where, being united together by a particular membrane, one of them joins the upper ſide, and the other the lower ſide of the obturator internus, a little after it has paſſed over the notch: They incloſe it as in a bag, and continue to be fixed to it by fleſhy fibres all the way to its extremity.

OBTURATOR EXTERNUS.

This is a ſmall flat muſcle, which fills up the foramen ovale of the os innominatum exteriorly, and reaches from

from thence to the great trochanter of the os femoris, behind the neck of that bone.

It is fixed by flefhy fibres to the outer anterior fide of the os pubis, all the way to the foramen ovale, to the edge of that hole, next the fmall ramus of the ifchium, and a little to the neighbouring parts of the obturator ligament.

From thence its fibres, contracting in breadth, pafs on the forefide of the great ramus of the ifchium, under the acetabulum, where a tendon is formed, which continues its courfe behind the neck of the os femoris toward the great trochanter, and is inferted between the gemelli and quadratus, in a fmall foffula between the apex of the great trochanter, and the bafis of the collum femoris.

QUADRATUS.

This is a fmall, flat, flefhy mufcle, of the figure of an oblong fquare, from whence it has it name. It is fituated tranfverfely between the tuberofity of the ifchium and the great trochanter.

It is fixed by one extremity along that obtufe line which runs from under the acetabulum, toward the lower part of the tuberofity of the ifchium. From thence it runs directly toward the great trochanter, and is inferted in almoft all the lower half of the oblong eminence in that apophyfis; but chiefly in the fmall rifing or tuberofity in the middle of that eminence.

MUSCULUS FASCIÆ LATÆ.

This is a fmall and pretty long mufcle, fituated a little obliquely upward and downward on the forepart of the hip.

It is fixed above to the outfide of the anterior fuperior fpine of the os ilium, between the infertions of the glutæus medius and fartorius. From thence its flefhy fibres run down a little obliquely backward, forming a very flat body, four fingers breadth in length, and two in breadth.

This body lies between two laminæ of the fafcia lata, and is inferted therein by fhort tendinous fibres, which difappear at that place where the fafcia adheres to the great trochanter and tendon of the glutæus maximus.

Uses *of the Mufcles which move the Os Femoris on the Pelvis.*

The glutæus maximus ferves chiefly, by its pofterior portion, to extend the os femoris, and to draw it backward. By its anterior portion, it may co-operate with the reft in performing the abduction of the thigh; but when we fit, it can do this office only by its pofterior portion.

By its infertion in the os coccygis, it may on fome occafions bring it forward, and hinder it from being thruft too far backward, as in the excretion of hardened fæces, or in difficult births.

The glutæus medius is commonly, but falfely, reckoned an extenfor of the thigh. Its ufe is to feparate one thigh from the other, when we ftand, and that more or lefs directly according to the action of its anterior, pofterior, or middle portions.

When we fit, the only ufe of this mufcle is to perform the rotation of the os femoris about its axis, in fuch a manner, that if the leg be bent at the fame time, it fhall be feparated from the other.

The glutæus minimus has likewife been reckoned an extenfor of the thigh, but without any foundation. It affifts the glutæus medius in the abduction of the thigh when we ftand, and in the rotation when we fit.

The pfoas bends the thigh on the pelvis, or brings it forward. It may likewife move the pelvis on the thighs, and hinder it from being carried along with the reft of the trunk, when the body is inclined backward while we fit, having the lower extremities fixed by fome external force. In this fituation it may likewife move the vertebræ of the loins.

The iliacus is a congener or affiftant to the pfoas, in bringing the thigh forward and upward. It may likewife move the pelvis in the fame manner with the former.

The pectineus is an affiftant to the two former mufcles in moving both the thigh and the pelvis. It may likewife affift in bringing the thigh inward, or toward the other, whether it be extended or bent at the fame time.

The three triceps mufcles join in the fame ufe; that is, to move the thigh inward, and bring the two thighs near each other; as when, in riding, we prefs the thighs clofe againft the faddle; when, in fitting, we hold any thing clofe between the knees; when we crofs the thighs; or when, in ftanding, we bring the legs clofe together, in order to jump.

The ufe of thefe mufcles is likewife to hinder the thighs from feparating more than is convenient, efpecially in great efforts and jerks.

The pyriformis, gemelli, and quadratus, called likewife by the common name of *quadrigemini*, are congeneres in their ufes; and thefe have been confined by anatomifts to the rotation of the os femoris about its axis from before outward, when we ftand or lie at full length; likewife in fitting, or when the thigh is bent in any other pofture, they carry the thigh outward, or feparate the two thighs from each other when bent.

All the four co-operate in thefe two ufes of rotation and abduction; but they co-operate equally or unequally, according to the different degrees of the extenfion or flexion of the thigh.

The obturator internus has nearly the fame ufes with the quadrigemini, in making the rotation of the thigh when extended, and the abduction when bent.

The obturator externus concurs with the internus in the fame ufes, though in a more fimple manner, and in a more uniform direction. It acts chiefly when the thigh is extended more or lefs.

The mufculus fafciæ latæ makes a rotation from before inwards, that is, in a contrary direction to that made by the quadrigemini and obturator internus; and this rotation is not fo much confined as that of the quadrigemini, becaufe it may have place whether the thigh be bent or extended.

Sect.

Sect. X. *The* Muscles *which move the Bones of the Leg on the Os Femoris.*

Rectus Anterior *ſive* Gracilis Anterior.

This muſcle is as long as the os femoris; and lies directly along the foreſide of the thigh, from whence it has the name of *rectus anterior*.

It terminates above, by a pretty ſtrong tendon, which is divided into two branches, one ſhort and ſtraight, the other long and bent. The ſhort branch, running up in a ſtraight line, is inſerted in the anterior inferior ſpine of the os ilium.

The long branch is inflected backward over the ſupercilium of the acetabulum, and runs in the direction thereof, from the ſpine toward the great iſchiatic ſinus. It is ſtrong and flat, adhering very cloſely to the bone, and covered by the orbicular ligament and the glutæus minimus.

From thence the muſcle runs down wholly fleſhy, and partly penniform, ſome of its fibres meeting above and ſeparating below. It is narrow at the upper extremity, and grows gradually broader toward the middle. Afterwards it contracts again in the ſame manner, and, at the lower extremity of the os femoris, ends in a flat broad tendon.

VASTUS EXTERNUS.

This is a very large fleſhy muſcle, almoſt as long as the os femoris, broad at the extremities, and thick in the middle, lying on the outſide of the thigh.

Its upper inſertion, being ſomething tendinous, is in the poſterior or convex rough ſurface of the great trochanter. It is likewiſe fixed by a fleſhy inſertion along the outſide of the os femoris for above two thirds of its length downward, in the correſponding part of the linea aſpera, and in the neighbouring portion of the faſcia lata.

From all this extent the fleſhy fibres running downward, and a little obliquely forward toward the rectus anterior, terminate inſenſibly in a kind of ſhort aponeuroſis, which is fixed in all the neareſt edge of the tendon of the rectus, in the ſide of the patella, in the edge of the ligament of that bone, and in the neighbouring lateral part of the head of the tibia.

VASTUS INTERNUS.

This muſcle is very like the former, and ſituated in the ſame manner on the inſide of the os femoris.

It is fixed above by a ſhort flat tendon, in the anterior rough ſurface of the great trochanter, and by fleſhy fibres in that oblique line which terminates the baſis of the collum femoris anteriorly, on the foreſide of the inſertions of the pſoas and iliacus, in the whole inſide of the os femoris, and in the linea aſpera on one ſide of the inſertions of the three tricipites, almoſt down to the internal condyle.

From all this extent the fibres run downward, and a little obliquely forward, and the body of the muſcle increaſes in the ſame manner as the vaſtus internus. It terminates below in an aponeuroſis, which is fixed in the edge of the tendon of the rectus anterior, in the ſide of the patella, and of its tendinous ligament, and in the ſide of the head or upper extremity of the tibia.

CRUREUS.

This is a fleſhy maſs, covering almoſt all the foreſide of the os femoris between the two vaſti, which likewiſe cover the edges of this muſcle on each ſide.

It is fixed to the foreſide of the os femoris, from the anterior ſurface of the great trochanter down to the loweſt quarter of the bone, by fleſhy fibres which run down ſucceſſively over each other, between the two vaſti, and are partly united to theſe two muſcles, ſo as not to ſeem to form a diſtinct muſcle.

It is not ſo thick as the two vaſti; and as it is covered by them on each ſide, a ſort of fleſhy channel is formed by all the three, in which the rectus is lodged, covering the forepart of the crureus.

It terminates below in a tendinous aponeuroſis, which joins the backſide of the tendon of the rectus anterior, and the neighbouring edges of the extremities of the two vaſti. Thus, theſe four muſcles form a common tendon, which is inſerted in the places already mentioned.

SARTORIUS.

This is the longeſt muſcle of the human body. It is flat, and about two fingers in breadth, ſituated obliquely along the inſide of the thigh.

It is fixed above by a very ſhort tendon, in the lower part of the anterior ſuperior ſpine of the os ilium, before the muſculus faſciæ latæ. The beginning of its body lies in the notch between the two anterior ſpines of that bone.

From thence it runs down obliquely over the vaſtus internus and other muſcles that lie near it, all the way to the inſide of the knee, where it terminates in a ſmall tendon, which grows broader near its extremity, and is inſerted obliquely and a little tranſverſely in the forepart of the inſide of the head of the tibia, near the ſpine or tuberoſity of that bone, immediately above the inſertion of the gracilis interior.

Gracilis Interior *ſive* Rectus Interior.

This is a long thin muſcle, lying in a ſtraight line on the inſide of the thigh, between the os pubis and the knee.

It is fixed in the edge of the inferior branch of the os pubis, near the ſymphyſis, by a broad and very ſhort tendon, on one ſide of the inſertion of the triceps ſecundus, but a little lower down.

From thence the fleſhy fibres contracting a little in breadth, run down to the internal condyle of the os femoris, where they terminate in a thin tendon, which afterwards degenerates into a kind of aponeuroſis, and is inſerted in the fore-part of the inſide of the head of the tibia.

BICEPS.

THIS muſcle is made up of two portions, one long, the other ſhort, and they end in a common tendon. Both portions are fleſhy and conſiderably thick, being ſituated on the back and outſide of the thigh, between the buttock and ham.

The great portion is fixed above, by a ſtrong tendon, in the poſterior and lower part of the tuberoſity of the iſchium, under the inſertion of the inferior gemellus, and cloſe behind that of the ſemi-nervoſus. From thence it runs down toward the lower extremity of the thigh, where it meets the other portion, and joins with it in forming a common tendon.

The ſmall portion is fixed, by fleſhy fibres, to the outſide of the linea aſpera, below its middle, and to the faſcia lata, where it forms a ſeptum between the triceps and vaſtus externus. From thence the fibres run down a little way, and then meeting the great portion, a common tendon is formed between them.

This ſtrong tendon runs down to the outer and back-part of the knee, and is inſerted in the lateral ligament of the joint, and in the head of the fibula, by two very ſhort tendinous branches.

SEMI-NERVOSUS.

THIS is a long muſcle, half fleſhy and half tendinous, or like a nerve, from whence it has its name. It is ſituated a little obliquely, on the poſterior and inner part of the thigh.

It is fixed above to the poſterior part of the tuberoſity of the iſchium, immediately before, and a little more inward than the biceps. It is afterwards fixed, by fleſhy fibres, to the tendon of the biceps, for about the breadth of three fingers, much in the ſame manner as the coraco-brachialis is fixed to the biceps of the arm.

From thence it runs down fleſhy toward the lower part of the inſide of the thigh, having a ſort of tendinous interſection in the inner part of its fleſhy portion. Having reached below the middle of the thigh, it terminates in a ſmall, long, round tendon, which runs down to the inſide of the knee, behind that of the gracilis, where it expands in breadth.

It is inſerted in the inſide of the upper part of the tibia, about two or three fingers breadth below the tuberoſity or ſpine, immediately under the tendon of the gracilis internus, with which it communicates.

SEMI-MEMBRANOSUS.

THIS is a long thin muſcle, partly tendinous, from whence it has its name, and ſituated on the back-ſide of the thigh, a little towards the inſide.

It is fixed above, by a broad tendon or long aponeuroſis, in the irregular, obtuſe, prominent line which goes from the acetabulum to the tuberoſity of the iſchium, a little above the inſertion of the ſemi-nervoſus, and between thoſe of the gemellus inferior and quadratus.

From thence it runs down fleſhy in an oblique direction behind the inner condyle of the os femoris, below which it terminates in a thick tendon, which is inſerted in the poſterior and interior ſide of the inner condyle of the tibia, by three ſhort branches, the firſt or uppermoſt of which goes a little toward the inſide, the ſecond more backward, and the third lower down.

POPLITEUS.

THIS is a ſmall muſcle, obliquely pyramidal, ſituated under the ham.

It is fixed above, by a ſtrong narrow tendon, to the outer edge of the inner condyle of the os femoris, and to the neighbouring poſterior ligament of the joint. From thence it runs obliquely downward under the inner condyle of the os femoris; it is a flat and pretty thick fleſhy body, increaſing gradually in breadth, till it is fixed in the back-ſide of the head of the tibia, all the way to the oblique line or impreſſion obſervable on that ſide.

USES *of the Muſcles which move the Bones of the Leg on the Os Femoris.*

THE two vaſti and crureus ought to be looked upon as a true triceps, the uſes of which, in relation to the bones, are only to extend the tibia on the os femoris, and the os femoris on the tibia. The extenſion of the tibia on the os femoris happens chiefly when we ſit or lie, and that of the os femoris on the tibia when we ſtand or walk. All the three muſcles move the patella uniformly in the direction of the os femoris, on the pulley at the lower extremity of that bone.

The inſertion of both the vaſti immediately in the head of the tibia, prevents the patella from being luxated laterally on ſome occaſions, in which the muſcles may act with more force on one ſide than on the other, or remain without action, in which caſe the patella is looſe and floating.

The rectus anterior, by its inſertion in the patella, is a congener to the laſt three muſcles, and ſerves to extend the leg. By its inſertion in the os ilium, it bends the thigh, and aſſiſts the pſoas, iliacus, and pectineus, whether the leg be extended or bent. It likewiſe moves the pelvis forward on the os femoris, and hinders it from falling back when we ſit.

The ſartorius performs the rotation of the thigh from before outward, whether extended or bent; being an antagoniſt to the muſculus faſciæ latæ, and a congener to the quadrigemini.

It likewiſe bends the thigh, or raiſes it forward; it moves the pelvis forward on the femoris; and when the pelvis reſts on the two tuberoſities of the iſchium in ſitting, it keeps it in that ſituation.

Laſtly, it bends the leg, whether it performs the rotation of the thigh at the ſame time or not.

The gracilis internus bends the leg much in the ſame manner with the ſartorius, which it aſſiſts in this function, but not in that of turning the leg.

It may likewiſe aſſiſt the triceps in the adduction of the thigh, which it performs with much more facility than it begins the flexion of the leg without the rotation of the thigh.

The

The ſemi-nervoſus bends the leg, and may likewiſe bend the thigh on the leg. By its inſertion in the tuberoſity of the iſchium, it likewiſe extends the thigh on the pelvis, and carries it backward; and may alſo extend the pelvis on the thigh, when it has been inclined forward with the reſt of the trunk; and conſequently prevent its being carried too far along with the trunk, when we ſtoop forward, either ſtanding or ſitting.

The ſemi-membranoſus has the ſame uſes with the ſemi-nervoſus. It bends the leg on the thigh, and the thigh on the leg; it extends the thigh on the pelvis, and the pelvis on the thigh, and ſuſtains the pelvis when it is inclined forward.

The two portions of the biceps bend the leg on the thigh, and the thigh on the leg. The ſuperior portion likewiſe extends the thigh on the pelvis, and the pelvis on the thigh. Theſe four uſes in general are common to this muſcle with the ſemi-membranoſus, and in ſome meaſure with the ſemi-tendinoſus.

The particular uſe of the biceps, and which ſeems to belong more to the ſhort portion than to the other, is to perform the rotation of the leg when bent, by which motion the toes are turned outward, and the heel inward.

The popliteus performs the rotation of the leg when bent, in a direction contrary to that of the biceps. The biceps turns the leg from before outward; the popliteus from before inward.

Sect. XI. *The* Muscles *which move the Tarſus on the Leg.*

TIBIALIS ANTICUS.

This is a long muſcle, fleſhy at the upper part, and tendinous at the lower, ſituated on the fore-ſide of the leg, between the tibia and the extenſor digitorum longus.

It is fixed above, by fleſhy fibres, in the upper third part of the external labium of the criſta tibiæ, and of the inſide of the aponeuroſis tibialis, or of that ligamentary expanſion which goes between the criſta tibiæ and the anterior angle of the fibula. It is likewiſe fixed obliquely in the upper two thirds of the outſide of the tibia, or that next the fibula.

From thence it runs down and ends in a tendon, which firſt paſſes through a ring of the common annular ligament, and then through another ſeparate ring ſituated lower down. Afterwards the tendon is fixed, partly in the upper and inner part of the os cuboides, and partly in the inſide of the firſt bone of the metatarſus.

Peronæus Medius *vulgo* Peronæus Anticus.

This is a long muſcle, ſituated anteriorly on the middle part of the fibula.

It is fixed above, by fleſhy fibres, to more than the middle third part of the anterior or outſide of the fibula, and to the neighbouring part of the aponeuroſis tibialis.

It is likewiſe fixed to a production from the inſide of that aponeuroſis which runs to the upper part of the tibia, and there ſerves for a middle ſeptum between this muſcle and the extenſor digitorum longus.

From thence it runs down and forms a tendon, which going in the direction of the oblique line on the fibula, paſſes behind the external malleolus, and then through an annular ligament common to it and to the peronæus maximus, and is afterwards inſerted in the tuberoſity at the baſis of the fifth metatarſal bone, ſending off a ſmall tendon to the firſt phalanx of the little toe.

PERONÆUS MINIMUS.

This is a ſmall muſcle, commonly thought to be a portion of the extenſor digitorum longus, though it is eaſily ſeparable from it.

It is fixed, by fleſhy fibres, in the lower half of the inſide of the fibula, between two oblique bony lines, on one ſide of the lower part of the extenſor digitorum longus, to which muſcle it is ſimply contiguous.

From thence it runs down contracting in breadth, and paſſes with the extenſor longus, through the common annular ligament, forming a flat tendon, which ſoon ſeparates from thoſe of the extenſor, and is inſerted near the baſis of the fifth metatarſal bone.

GASTROCNEMII.

These are two thick, pretty broad, and oblong muſcles, ſituated laterally with reſpect to each other, in the ſame plane, under the poples, and forming a great part of what is called the calf of the leg. That which lies next the tibia is called *internus*, and that next the fibula, *externus;* and becauſe they form, as it were, the belly of the leg, they have been termed in Greek *gaſtrocnemii*.

Each muſcle is fixed above, by a flat tendon, to the poſterior part of the lower extremity of the os femoris, behind the lateral tuberoſity of each condyle, adhering cloſely to the poſterior ligaments of the joint of the knee.

From thence they run down, each forming a large and pretty broad fleſhy body, irregularly oval.

About the middle of the leg, they end in a ſtrong, broad, common tendon, which contracts a little in breadth as it deſcends, and is inſerted in the poſterior extremity of the os calcis, together with the tendon of the ſoleus.

SOLEUS.

This is a large, fleſhy, flat muſcle, nearly of an oval figure, and thicker in the middle than at the edges. It is ſituated on the back-ſide of the leg, lower down than the gaſtrocnemii, by which it is covered; and theſe three muſcles form the calf of the leg.

It is fixed above, partly to the tibia, and partly to the fibula.

Afterwards leaving theſe two bones, it ends in a broad ſtrong tendon, which, together with that of the gaſtrocnemii, forms what is called *tendo Achillis*. This ſtrong tendon contracts a little in its paſſage to the os calcis, and then expanding a little, it is inſerted obliquely in the back-ſide of that bone, all the way to the tuberoſity.

TIBIALIS GRACILIS *vulgo* PLANTARIS.

This is a ſmall pyriform muſcle, ſituated obliquely in the ham below the external condyle of the os femoris, between the popliteus and gaſtrocnemius externus; and its tendon, which is long, flat, and very ſmall, runs down on the ſide of the gaſtrocnemius internus, all the way to the heel.

The fleſhy body, which is only about two inches in length, and one in breadth, is fixed, by a ſhort flat tendon, above the outer edge of the exterior condyle of the os femoris, on one ſide of the gaſtrocnemius externus. From thence the fleſhy body runs obliquely over the edge of the popliteus, and terminates in a very ſmall, long, flat tendon.

This tendon runs between the body of the gaſtrocnemius externus and ſoleus, all the way to the inner edge of the upper part of the tendo Achillis; and from thence continuing its courſe downward, it joins this tendon, and is inſerted, together with it, in the outſide of the poſterior part of the os calcis, without communicating with the aponeuroſis plantaris.

TIBIALIS POSTICUS.

This is a long, fleſhy, penniform muſcle, broader above than below, ſituated between the tibia and fibula, on the back-ſide of the leg, and covered by the extenſor digitorum longus.

It is fixed above, by fleſhy fibres, immediately under the articulation of the tibia and fibula, to the neareſt parts of theſe two bones, chiefly to the tibia, reaching to the lateral parts of that bone, above the interoſſeous ligament, which is here wanting.

From thence its inſertion is extended below the oblique line or impreſſion in the tibia, over all the neighbouring part of the interoſſeous ligament, and through more than the upper half of the internal angle of the fibula.

After this, it forms a tendon, which runs down behind the inner malleolus, through a cartilaginous groove and an annular ligament, and, paſſing under the malleolus, is inſerted in the tuberoſity or lower part of the os ſcaphoides.

Peronæus Maximus *vulgo* Peronæus Posterior.

This is a long penniform muſcle, lying on the fibula.

It is fixed above to the anterior and outer part of the head of the fibula, and to a ſmall portion of the head of the tibia; then to the outſide of the neck of the fibula, to the upper half of the external angle of that bone, and to the aponeuroſis tibialis, which at that place makes a ſeptum between this muſcle and the extenſor pollicis.

From thence turning a little backward, according to the direction of the bone, it forms a conſiderable tendon, which, running behind the external malleolus, paſſes through a kind of hollow groove, and through an annular ligament common to it and to the tendon of the peronæus medius, which lies before it.

Afterwards running through the oblique groove in the lower ſide of the os cuboides, it is inſerted in the ſide of the baſis of the firſt metatarſal bone, and alſo a little in the baſis of the os cuneiforme majus.

Sect. XII. *The* Muscles *which move the Metatarſus and Toes.*

EXTENSOR POLLICIS LONGUS.

This is a thin ſingle muſcle, lying between the tibialis anticus and extenſor digitorum longus, by which it is almoſt hid.

It is fixed to the inſide of the fibula, near the interoſſeous ligament, from the neck down to the loweſt quarter of that bone; to the interoſſeous ligament through the ſame ſpace, and a little to the lower extremity of the tibia next the fibula.

There it ends in a conſiderable tendon, which paſſing through a diſtinct ring of the common annular ligament, and then through a membranous vagina, is inſerted in the baſis of the firſt phalanx of the great toe, and continued from thence up to the ſecond.

FLEXOR POLLICIS LONGUS.

This is a pretty long muſcle, ſituated in the poſterior and lower part of the leg.

It is fixed in the lower half of the back-ſide of the fibula, its inſertion reaching almoſt as far as the external malleolus. The fleſhy body advances on the inſide of that bone towards the tibia, according to the oblique direction of that ſide, and ends in a large tendon.

This tendon paſſes behind the lower extremity of the tibia, toward the inner ankle, then through a ſmall notch in the inner and back-ſide of the aſtragalus, and through an annular ligament or ligamentary vagina, continued under the lateral arch of the os calcis.

From thence it advances to the great toe, and paſſing through the interſtice between the two ſeſamoid bones, in the ligamentary vagina of the firſt phalanx, is inſerted in the lower part of the ſecond.

THENAR.

This muſcle is made up of ſeveral portions, and lies on the inner edge of the ſole of the foot.

It is fixed, by three or four fleſhy faſciculi, to the lower and inner part of the os calcis, os ſcaphoides, and os cuneiforme majus. It is likewiſe fixed a little in the annular ligament under the inner ankle, which belongs to the tendon of the flexor longus.

From all theſe different inſertions, the fleſhy faſciculi approach each other as they advance forward under the firſt bone of the metatarſus, and are fixed, partly in the internal ſeſamoid bone, and partly in the inſide of the firſt phalanx, near its baſis.

ANTITHENAR.

This is a ſmall compound muſcle, lying obliquely under the metatarſal bones.

It

It is fixed posteriorly in the lower parts of the second, third, and fourth metatarsal bones, near their basis; in the ligament belonging to the first and second of these bones; in the neighbouring ligaments belonging to the bones of the tarsus; and, lastly, in a lateral aponeurosis of the muscle commonly called *hypothenar*.

All these portions, contracting into a small compass, are inserted in the outside of the external sesamoid bone, and of the first phalanx of the great toe.

EXTENSOR DIGITORUM LONGUS.

This is a long muscle, fleshy in the upper part, and tendinous in the lower, lying between the tibialis anticus and peronæus maximus.

It is fixed above, by fleshy fibres, in the outside of the head of the tibia, and inside of the head of the fibula; in the upper part of the interosseous ligament, through three fourths of the length of the fibula; and through the same space, in the tendinous septum belonging to the anterior angle of that bone.

It contracts in breadth a little above the annular ligament, and, in passing through it, is divided into three tendons; the first of which is afterwards divided into two. These four tendons are inserted along the upper or convex side of the four small toes.

EXTENSOR DIGITORUM BREVIS.

This is a small complex muscle, lying obliquely on the convex side of the foot, being likewise termed *pedieus*.

It is fixed in the upper and outer side of the anterior apophysis of the astragalus, and in the neighbouring part of the upper side of that bone. From thence it runs obliquely from without inwards, under the tendons of the peronæus minimus and extensor digitorum longus, being divided into four fleshy portions, which terminate in the same number of tendons.

The first tendon is inserted in the upper or convex part of the first phalanx of the great toe. The other three joining with those of the extensor longus, are inserted along the convex sides of all the phalanges of the three following toes.

FLEXOR DIGITORUM BREVIS *sive* PERFORATUS PEDIS.

This is the undermost of all the common muscles of the toes, being situated immediately above the aponeurosis plantaris.

It is fixed by fleshy fibres to the anterior and lower part of the great tuberosity of the os calcis; and to the neighbouring part of the upper side of the aponeurosis plantaris.

From thence it runs forward, being divided into four fleshy portions, which terminate in the same number of tendons, split at their extremities, in the same manner as those of the sublimis or perforatus of the hand, and inserted in the second phalanges of the four small toes.

FLEXOR DIGITORUM LONGUS *sive* PERFORANS PEDIS.

This is a long muscle, fleshy above, and tendinous below, lying on the backside of the leg between the tibia and the flexor pollicis longus, covered by the soleus, and covering the tibialis posticus.

It is fixed above, by fleshy fibres, to a little more than the middle third part of the backside of the tibia near its external angle, below the insertion of the soleus; and also to a kind of ligament which runs down from the middle of the tibia. It afterwards ends in a tendon which passes behind the inner ankle, on one side, and a little behind the tibialis posticus, in a separate annular ligament.

From thence it runs under the sole of the foot, sending off a detachment, by which it communicates with the flexor pollicis longus. There it is divided into four small flat tendons, which go to the third phalanges of the four small toes in the same manner, as the perforans of the hand.

FLEXOR DIGITORUM ACCESSORIUS.

This is a flat and pretty long fleshy mass, situated obliquely under the sole of the foot.

This muscle is fixed posteriorly by one fleshy portion, in the lower side of the os calcis, and in the anterior tuberosity on that side, and by the other in the neighbouring ligament which joins this bone to the astragalus.

From thence the two portions run obliquely to the middle of the sole of the foot, and there unite in a flat, long, and irregularly square muscular mass, which is fixed to the outer edge of the fasciculus of tendons of the flexor longus, to which it serves as a frænum at that place.

LUMBRICALES.

These are four small muscles, situated more or less longitudinally under the sole of the foot.

They are fixed by their fleshy extremities to the four tendons of the flexor digitorum longus near the insertion of the flexor accessorius. The first muscle is fixed to the inside of the first tendon; the second to the tendinous fork formed by the two first tendons; the third, to the tendinous fork made by the second and third tendons; and the fourth, in the same manner to the third and fourth tendons, but commonly most to the third.

From thence these four muscles run to the toes, and there terminate in the same number of small tendons, which are inserted in the first phalanges of the toes, much after the same manner as in the hand.

TRANSVERSALIS DIGITORUM.

This is a small muscle, which lies transversely under the basis of the first phalanges, and which at first sight appears to be a simple muscular body fixed by one end to the great toe, and by the other to the little toe.

When

When this muſcle is carefully examined, we find that it is fixed, by a very ſhort common tendon, to the outſide of the baſis of the firſt phalanx of the great toe, conjointly with the antithenar; and, by three different portions or digitations, to the three interoſſeous ligaments which connect the heads of the four metatarſal bones next the great toe, laterally to each other.

INTEROSSEI.

THESE are ſeven ſmall muſcles which fill up the four interſtices between the metatarſal bones, much after the ſame manner as in the hand. The four largeſt are ſuperior, the other three inferior.

METATARSIUS.

THIS is a fleſhy maſs, lying under the ſole of the foot. It is fixed, by one end, in the fore-part of the great tuberoſity of the os calcis; and running forward from thence, it terminates in a kind of ſhort tendon, which is fixed in the tuberoſity and poſterior part of the lower ſide of the fifth bone of the metatarſus.

PARATHENAR MAJOR.

THIS is a pretty long muſcle, forming part of the outer edge of the ſole of the foot.

It is fixed backwards by a fleſhy body, to the outer part of the lower ſide of the os calcis, from the ſmall poſterior external tuberoſity, all the way to the anterior tuberoſity. There it joins the metatarſius, and at the baſis of the fifth metatarſal bone ſeparates from it again, and forms a tendon, which is inſerted in the outſide of the firſt phalanx of the little toe, near its baſis, and near the inſertion of the parathenar minor.

PARATHENAR MINOR.

THIS is a fleſhy muſcle, fixed along the poſterior half of the outer and lower ſide of the fifth bone of the metatarſus. It terminates under the head of that bone, in a tendon which is inſerted in the lower part of the baſis of the firſt phalanx of the little toe.

USES *of the Muſcles which move the Tarſus and the other Bones of the Foot.*

THE tibialis anticus bends the foot, that is, turns the point of the foot toward the leg; which motion is performed by the ginglymoid articulation of the aſtragalus with the tibia and fibula. It likewiſe bends the leg on the foot, or hinders its extenſion.

By its lateral inſertion in the os cuneiforme maximum, it moves this bone in particular over the anterior extremity of the os calcis; by which the ſole of the foot is turned inward toward the other.

The peronæus medius bends the foot, and hinders the leg from falling back in the ſame manner as the tibialis anticus. By its inſertion in the tuberoſity of the fifth metatarſal bone, it turns the ſole of the foot outward at the ſame time that it bends it, when it acts without the aſſiſtance of the tibialis anticus.

The peronæus minimus is an aſſiſtant to the medius in the flexion of the foot, in preſerving the æquilibrium of the leg, and in turning the ſole of the foot outward.

THE gaſtrocnemii and ſoleus make a kind of triceps; and, by their common tendon, extend the foot, and keep it extended againſt the ſtrongeſt reſiſtance. It is by their means that we raiſe the whole body, even with an additional burden, when we ſtand a tip-toes; and that we walk, run and jump.

The gaſtrocnemii, by their inſertion in the os femoris, may, in great efforts, move the leg on the thigh, and the thigh on the leg, as aſſiſtants to the biceps, ſemimembranoſus, ſemi-tendinoſus, gracilis internus, and ſartorius.

The ſoleus, by the multitude of its fleſhy fibres and its penniform ſtructure, is more proper for ſtrong than large motions, and ſeems principally to ſuſtain the gaſtrocnemii in the motions begun by them. The tendinous portions of this muſcle and of the gaſtrocnemii, tho' they form a ſtrong tendon all together, ſeem nevertheleſs to ſlide a little upon each other in the different flexions and extenſions of the foot.

Anatomiſts are not agreed with regard to the uſe of the tibialis gracilis.

When the tibialis poſticus acts alone, it extends the foot obliquely inward. When it acts together with the gaſtrocnemii and ſoleus, it changes the ſtreight direction of their motion to an oblique one. When it acts with the tibialis anticus, the ſole of the foot is turned more directly inward, or toward the other foot.

When the peronæus longus or maximus acts alone, it may extend the foot hanging freely in the air; but then this extenſion is obliquely outward. Together with the gaſtrocnemii and ſoleus, it likewiſe changes their direction to an oblique extenſion outward.

The extenſor pollicis longus extends the two phalanges of the great toe; and it may likewiſe be an aſſiſtant to the tibialis anticus.

The flexor pollicis longus not only bends the ſecond phalanx of the great toe, but may likewiſe ſerve, in great efforts, as an aſſiſtant to the extenſors of the tarſus. This muſcle is of great uſe in climbing up a ſteep place.

The thenar bends the firſt phalanx of the great toe. When the portion neareſt the inner edge of the foot either acts alone, or acts more than the reſt, the great toe is ſeparated from the other toes, eſpecially if it be at the ſame time extended.

The antithenar, acting with the thenar, bends the firſt phalanx of the great toe. When it acts alone, eſpecially if the great toe is bent, it brings it nearer the other toes, in proportion to the degrees of action of its different portions

The two extenſores digitorum communes concur in extending the four ſmall toes; and, as the extenſor longus is not near ſo fleſhy as that of the hand, this difference is made up by the extenſor brevis. The longus alone ſeems to extend the firſt phalanges; and they both join in the extenſion of the ſecond and third phalanges; the brevis, by the obliquity of its direction, moderating the action

action of the longus, which otherwise would have turned the toes obliquely the contrary way.

The perforatus or flexor digitorum brevis, bends the second phalanges; and the perforans or flexor longus, the third; the use of these muscles being nearly the same with those of the perforatus and perforans of the hand.

The flexor accessorius is an assistant to the perforans, increasing its force on some occasions. It likewise directs the tendon of that muscle; for by contracting, at the same time that the fleshy belly of the perforans is in action, it makes the tendons go in a straighter line to the toes than they would otherwise do, because of their obliquity.

The lumbricales have nearly the same functions in the foot as in the hand; and they are partly assisted, and partly directed, by the flexor accessorius.

The interossei of the foot have the same uses as in the hand. The first superior muscle brings the second toe near the great toe; the other three bring the second, third, and fourth toes near the little toe. The three inferior muscles move the last three toes toward the other two.

The metatarsius moves the last bone of the metatarsus, much in the same manner as the metacarpius does that of the metacarpus.

The transversalis may assist the metatarsius in this action, which is supposed to be of use to tilers in climbing. The antithenar may likewise concur, and the peronæus minimus may serve to counterbalance these muscles, and to bring the metatarsus back to its natural situation.

The parathenar major serves particularly to separate the little toe from the rest; and the parathenar minor bends the first phalanx of that toe.

Sect. XIII. *The* Muscles *employed in Respiration.*

DIAPHRAGMA.

This is a very broad and thin muscle, situated at the basis of the thorax, and serving as a transverse partition to separate that cavity from the abdomen. For this reason the Greeks termed it *diaphragma*; and and the Latins, *septum transversum*. It forms an oblique inclined arch, the fore-part of which is highest, and the posterior part lowest, making a very acute angle with the back.

It is looked upon as a double and digastric muscle, made up of two different portions, one large and superior, called the great muscle of the diaphragm; the other small and inferior, appearing like an appendix to the other, called the small or inferior muscle of the diaphragm.

The great or principal muscle is fleshy in its circumference, and tendinous and aponeurotic in the middle, which, for that reason, is commonly called *centrum nervuum sive tendinosum.*

The fleshy circumference is radiated, the fibres of which it is made up being fixed by one extremity to the edge of the middle aponeurosis, and by the other to all the basis of the cavity of the thorax, being inserted by digitations in the lower parts of the appendix of the sternum, of the lowest true ribs, of all the false ribs, and in the neighbouring vertebræ.

We have therefore three kinds of insertions; one sternal; twelve costal, six on each side; and two vertebral, one on each side. These last are very small, and sometimes scarcely perceivable. The costal insertions join those of the transversalis abdominis, but do not mix with them, as they seem to do before the membrane which covers them is removed.

The fibres inserted in the appendix ensiformis, run from behind directly forward, and form a small parallel plane.

The first costal insertion runs a little obliquely towards the cartilage of the seventh true rib, a triangular space being left between this and the sternal insertion, at which the pleura and peritonæum meet. The insertion of these fibres is very broad, taking up about two thirds of the cartilage of the seventh rib, and a small part of the bone, from whence it reaches beyond the angle of the cartilage.

The second insertion is into the whole cartilage of the first false rib; the third partly in the bone, and partly in the cartilage of the second false rib; the fourth in the bone, and sometimes a little in the cartilage of the third false rib; the fifth in the bone, and a little in the cartilage of the fourth false rib, being broader than the rest.

The sixth is in the cartilage of the last false rib, and almost through the whole length of the bone. At the head of this rib, it joins the vertebral insertion, which runs from the lateral part of the last vertebra of the back, to the first vertebra of the loins.

The small muscle of the diaphragm is thicker than the other, but of much less extent. It is situated along the foreside of the bodies of the last vertebra of the back and several of those of the loins, being turned a little to the left hand. It is of an oblong form, representing in some measure a fleshy collar, the two lateral portions of which cross each other, and afterward become tendinous toward the lower part.

The upper part of the body of this muscle is fixed in the slope of the middle aponeurosis of the great muscle. The outer edges of the alæ or lateral portions join the posterior plane of the great muscle, and these portions adhere to the body of the last vertebra of the back. The extremities, called likewise *pillars* or *crura*, are inserted by several tendinous digitations in the vertebræ of the loins.

The upper part of the fleshy body is formed by a particular intertexture of fibres belonging to the two alæ. These two alæ, whereof that toward the right-hand is generally the most considerable, part from each other, and form an oval hole, terminated on the lower part by fibres, detatched from the inside of each ala, immediately above the last vertebra of the back. These fibres decussate and cross each other, and afterwards those that come from each ala join that on the other side, so that each of the crura is a production of both alæ.

The fibres that come from the left ala, crofs over thofe from the right ala, and this again fends a fmall fafciculus of fibres over thofe of the left ala; afterwards the two crura part from each other.

The right crus is larger and longer than the left, and is always inferted in the four upper vertebræ of the loins, and often in the fifth likewife, by the fame number of digitations, which become more and more tendinous as they defcend, and at length are expanded in form of an aponeurofis. This crus lies more on the middle of the bodies of the vertebræ than on the right fide.

The left crus is fmaller and fhorter, and lies more on the fides of the vertebræ. It is fixed by digitations to the three upper vertebræ of the loins, feldom reaching lower. The lower part of it is expanded in the fame manner as the other; and the two expanfions fometimes meet together.

The oval opening of this inferior mufcle of the diaphragm, gives paffage to the extremity of the œfophagus, and the aorta lies in the interftice between the two crura. Immediately above the opening or hole, a thin fafciculus of fibres is fent off to the ftomach.

In the middle aponeurofis of the great mufcles, a little to the right of the anterior part of the flope, near the fmall mufcle, is a round opening, which tranfmits the trunk of the lower vena cava. The border or circumference of this opening is very artfully formed by an oblique and fucceffive intertexture of tendinous fibres, almoft like the edge of a wicker bafket; and is, confequently, incapable either of dilatation or contraction, by the action of the diaphragm.

We find therefore three confiderable openings in the diaphragm; one round and tendinous, for the paffage of the vena cava; one oval and flefhy, for the extremity of the œfophagus; and one forked, partly flefhy, and partly tendinous, for the aorta. The round opening is to the right-hand, clofe to the upper part of the right ala of the fmall mufcle; the oval opening is a little to the left; fo that the right ala, which is between thefe two holes, lies almoft directly over againft the middle of the body of the eleventh vertebra of the back; the tendinous fork is under the oval opening, but a little more toward the middle.

SCALENI.

These are compound mufcles, irregularly triangular.

The fcalenus primus is fixed to the upper part of the outfide of the firft rib, by two diftinct portions, called commonly *branches;* one anterior, the other pofterior. The anterior branch is fixed to the middle portion of the rib, about an inch from the cartilage. From thence it runs obliquely upward, and is inferted in the tranfverfe apophyfis of the fixth, fifth, and fometimes of the third vertebra of the neck.

The pofterior branch is fixed more backward in the firft rib, an interftice of about an inch being left between it and the other branch, through which the axillary artery and brachial nerves are tranfmitted. From thence it runs up obliquely behind the former, and is inferted in all the tranfverfe apophyfes of the neck.

The fcalenus fecundus is fixed a little more backward in the external labium of the upper edge of the fecond rib, fometimes by two feparate portions, and fometimes without any divifion. The anterior portion is fixed immediately under the pofterior portion of the firft fcalenus, by a fhort flat tendon, united a little with the firft intercoftal mufcle. From thence it runs up over the pofterior portion of the firft fcalenus, communicating likewife with that mufcle, and is fixed by infertions, partly tendinous and partly flefhy, in the tranfverfe apophyfes of the four firft vertebræ of the neck.

The pofterior portion is fixed in the fecond rib, more backward than the other. From thence it runs up, being divided into two portions, whereof one is inferted in the tranfverfe apophyfes of the three firft vertebræ of the neck, behind the fcalenus primus. The other portion runs up behind the former, and is inferted in the tranfverfe apophyfes of the two firft vertebræ.

SERRATUS POSTICUS SUPERIOR.

This is a flat thin mufcle, fituated on the upper part of the back. It is fixed on one fide, by a broad aponeurofis, to the lower part of the pofterior cervical ligament, and to the fpinal apophyfes of the two laft vertebræ of the neck, and two firft of the back.

From thence it runs down a little obliquely forward, and is inferted, by broad flefhy digitations, in the pofterior part of the fecond, third, fourth, and fometimes of the fifth true ribs, near their angles; but fometimes it has no infertion in the fecond rib.

SERRATUS POSTICUS INFERIOR.

This is a flat thin mufcle, lying on the lower part of the back. It is fixed in the laft fpinal apophyfis of the back, and in the three firft of the loins, by a broad aponeurofis. From thence it runs up a little obliquely, and is fixed, by flefhy broad digitations, in the laft four falfe ribs. Its infertions, in the loweft rib, is near the cartilage, and, in the other three, near their angles.

INTERCOSTALES.

The intercoftal mufcles are thin, flefhy planes, lying in the interftices between the ribs, their fibres running obliquely from one rib to another. In each interftice lie two planes, an external and an internal, clofely joined together, nothing but a thin, fine, cellular, membranous web coming between them.

According to this natural divifion, there muft be forty-four intercoftal mufcles in the twenty-two interftices left between the twenty-four ribs; and of thefe there are eleven external, and eleven internal, on each fide. The fibres of the external intercoftals run down from behind forward, and thofe of the internal intercoftals from before backward; fo that the fibres of thefe two feries of mufcles crofs each other.

The external intercoftals extend commonly from the vertebræ to the extremity of the upper labium of the bony portion of each rib, and go no further. The internal

ternal begin forward near the ſternum, and end backward at the angle of each rib.

SUPRA-COSTALES.

These muſcles are irregularly triangular, and ſituated on the back-part of the ribs, near the vertebræ.

Each of theſe muſcles is fixed, by one tendinous extremity, in the tranſverſe apophyſis, which lies above the articulation of each rib, and to the neighbouring ligament; the firſt being inſerted in the tranſverſe apophyſis of the laſt vertebra of the neck; and the laſt, in that of the eleventh vertebra of the back.

From thence the fleſhy fibres run down obliquely, increaſing in breadth as they deſcend, and are inſerted in the back part of the outſide of the following rib.

SUB-COSTALES.

These are fleſhy planes, of different breadths, and very thin, ſituated more or leſs obliquely on the inſides of the ribs, near the bony angles, and running in the ſame direction with the external intercoſtals.

They are fixed by both extremities in the ribs; the inferior extremity being always at a greater diſtance from the vertebræ than the ſuperior, and ſeveral ribs lying between the two inſertions.

Sterno-Costales *vulgo* Triangularis Sterni.

These are five pairs of fleſhy planes, diſpoſed more or leſs obliquely on each ſide the ſternum, and on the inſide of the cartilages of the ſecond, third, fourth, fifth, and ſixth true ribs.

They are inſerted, by one extremity, in the edges of the inſide of all the lower half of the ſternum. From thence the firſt muſcle on each ſide runs up obliquely, and is fixed in the cartilage of the ſecond rib. The ſecond runs leſs obliquely to its inſertion in the cartilage of the third rib. The reſt are inſerted, in the ſame manner, in the cartilages of the following ribs.

This laſt muſcle is fixed, by one extremity, in the cartilage of the ſixth true rib, near the bone, and ſeems to paſs the appendix enſiformis, immediately above the inſertion of the diaphragm in that appendix, and to join the muſcle on the other ſide.

Uses *of the Muſcles employed in Reſpiration.*

The ſcaleni are ſometimes ranked among thoſe which ſerve for reſpiration; but they ought rather to be ranked among the muſcles which move the vertebræ of the neck; becauſe the articulation of the firſt rib on both ſides, with the firſt vertebra of the back, ſeems to ſerve only for the motion of that vertebra on the rib, and not of the rib on the vertebra.

The ſerratus poſticus ſuperior is diſpoſed to move upwards the three or four upper ribs next the firſt.

The ſerratus poſticus inferior is ſtill better diſpoſed for depreſſing and keeping down the laſt three or four falſe ribs.

The poſterior fibres of the external intercoſtals are fixed, by their upper extremities, ſo near the articulation of the ribs with the vertebræ, that they cannot depreſs that rib in which they are ſo inſerted; whereas the inſertions of their lower extremities in the following rib being at a greater diſtance from the articulation, they may move that rib upward. And from thence it follows, that all the remaining part of each external intercoſtal which terminates at the bony extremity of each rib, can only ſerve to raiſe the lower rib toward the upper.

The anterior fibres of the internal intercoſtals are ſo near the articulation of the ribs with the ſternum, that they cannot depreſs that cartilage in which each of them is inſerted; whereas the inferior inſertions of theſe fibres being at a greater diſtance from the articulation, they are in a condition to raiſe the cartilages in which they are ſo inſerted. From whence it follows, that all the internal intercoſtal muſcles have the ſame uſe with the external, and that they can have no other.

The ſupra-coſtales are powerful aſſiſtants to the intercoſtals in their common action, and are therefore very juſtly termed *levatores coſtarum.*

The ſterno-coſtales depreſs the cartilaginous portions, and anterior extremities of the ribs, eſpecially the ſuperior ribs, except the firſt; and at the ſame time draw the cartilages of the inferior ribs near the ſternum, by reaſon of the curvature. They may therefore very well be called *depreſſores coſtarum*, as the ſupra-coſtales are named *levatores*.

The ſub-coſtales having the ſuperior extremities of their fibres much more diſtant from the vertebral articulation of the ribs than the lower extremities, it follows, that they can more eaſily move the upper than the lower ribs, and conſequently that they are aſſiſtants to the ſterno-coſtales.

The diaphragm, together with the intercoſtal muſcles, the ribs, ſternum, and vertebræ of the back, forms the cavity of the thorax, and it divides this cavity from that of the abdomen.

Its particular uſe is to be the principal organ of reſpiration, that is, of the alternate expanſion and contraction of the thorax. The other muſcles already mentioned are to be conſidered only as aſſiſtants and directors, in order to facilitate and regulate theſe motions, which, in the ordinary ſtate, are perpetual, but which may, by the action of theſe other muſcles, be accelerated, retarded, or even be ſuſpended for ſome ſpace of time.

The diaphragm may move when the ribs are at reſt, and conſequently without the aſſiſtance of the muſcles which move the ribs; and this motion may be ſufficient to keep up the alternate dilatation and contraction of the thorax.

Sect. XIV. *The* Muscles *which move the Head on the Trunk.*

Sterno-Mastoidæus *ſive* Mastoidæus Anterior.

This is a long, narrow, pretty thick, and moſtly fleſhy muſcle, ſituated obliquely between the back part of

of the ear, and lower part of the throat. It is in a manner compoſed of two muſcles, united at the upper part through their whole breadth, and ſeparated at the lower.

It has two inſertions below, both of them flat, and a little tendinous. The firſt is in the upper edge of the ſternum, near the articulation of the clavicula; the other in the clavicula, at a ſmall diſtance from the ſternum.

The ſternal portion paſſes foremoſt, and covers the clavicular, both forming one body or belly, which running in the ſame oblique direction to the apophyſis maſtoidæus, is inſerted in the upper and back-part of that proceſs; over which it likewiſe ſends off a very broad aponeuroſis, which covers the ſplenius, and is inſerted in the os occipitis.

SPLENIUS *ſive* MASTOIDÆUS POSTERIOR.

This is a flat, broad, oblong muſcle, ſituated obliquely, between the back-part of the ear, and the poſterior and lower part of the neck. It is partly ſingle, and partly made up of two portions, one ſuperior, the other inferior.

The ſuperior portion is fixed to the extremities of the three or four loweſt ſpinal apophyſes of the neck, and of the firſt, or firſt and ſecond, of the back.

It is likewiſe fixed to the edge of the inter-ſpinal ligaments of the other vertebræ.

From thence it runs up obliquely toward the maſtoid apophyſis, partly under the upper extremity of the ſterno-maſtoidæus, and is inſerted in the upper part of that proceſs, and along the neighbouring curve portion of the tranſverſe ridge of the os occipitis.

The inferior portion of the ſplenius is fixed to three or four ſpinal apophyſes of the back, beginning by the ſecond or third. From thence it runs up, being cloſely united to the other portion, till it reaches the ſuperior and lateral part of the neck, where it ſeparates from it, and is inſerted in the tranſverſe apophyſes of the three or four ſuperior vertebræ of the neck, by the ſame number of extremities, a little tendinous, which, however, are ſometimes only two in number.

COMPLEXUS.

This is a pretty long and broad muſcle, lying on the poſterior lateral part of the neck, all the way to the occiput. It is complicated, by reaſon of the decuſſations of its different portions; from which it has its name.

It is fixed below, by ſmall ſhort tendons, to the tranſverſe apophyſes of all the vertebræ of the neck, except the firſt, to which it is fixed only near the root of its tranſverſe apophyſis. From thence it runs up obliquely backward, croſſing under the ſplenius, and often communicating with it, by ſome faſciculi of fibres.

It is afterwards inſerted above, by a broad fleſhy plane, in the poſterior part of the ſuperior tranſverſe line of the os occipitis, near the criſta or ſpine of that bone.

Complexus Minor *ſive* Mastoidæus Lateralis.

This is a long, ſlender, narrow indented muſcle, lying along all the ſide of the neck, up to the ear, where it increaſes a little in breadth.

It is fixed, by one extremity, in all the tranſverſe apophyſes of the neck, except the firſt, by the ſame number of digitations or branches, moſtly fleſhy, and diſpoſed obliquely.

From thence it aſcends, and having reached above the tranſverſe apophyſis of the firſt vertebra, it forms a ſmall broad plane, by which it is inſerted in the poſterior part of the apophyſis maſtoidæus.

RECTUS MAJOR.

This is a ſmall, flat, ſhort muſcle, broad at the upper part, and narrow at the lower, ſituated obliquely between the occiput and ſecond vertebra of the neck.

It is fixed below to one branch of the bifurcated ſpine of the ſecond vertebra of the neck, at a tuberoſity which is often found at the upper part of that branch. From thence it aſcends a little obliquely outward, and is inſerted in the poſterior part of the inferior tranſverſe line of the os occipitis, at a ſmall diſtance from the criſta, being a little covered by the obliquus ſuperior.

RECTUS MINOR.

This muſcle is like the former, and it has alſo a ſmall inſertion below, in the poſterior eminence of the firſt vertebra. From thence it aſcends laterally, and is inſerted immediately under the poſterior part of the inferior tranſverſe line of the os occipitis, in a ſuperficial foſſula on one ſide of the criſta occipitalis.

OBLIQUUS SUPERIOR *ſive* MINOR.

This muſcle is ſituated laterally between the occiput and firſt vertebra, being nearly of the ſame figure with the two recti. It is fixed to the end of the tranſverſe apophyſis of the firſt vertebra; from whence it runs upward and very obliquely backward, and is inſerted in the tranſverſe line of the os occipitis, almoſt at an equal diſtance from the criſta and maſtoid apophyſis, between the rectus major and complectus minor.

OBLIQUUS INFERIOR *ſive* MAJOR.

It is ſituated in a contrary direction to the obliquus ſuperior, between the firſt and ſecond vertebra of the neck, reſembling that muſcle in every thing but the ſize. It is fixed below to one ramus of the bifurcated ſpinal apophyſis of the ſecond vertebra, near the inſertion of the rectus major; from whence it runs obliquely upwards and outward, and is inſerted in the end of the tranſverſe apophyſis of the firſt vertebra, under the lower inſertion of the obliquus ſuperior.

RECTUS ANTICUS LONGUS.

This muſcle is, in ſome meaſure, of a pyramidal figure, lying along the anterior and lateral parts of the vertebra of the neck, all the way up the baſis cranii.

It

A. Bell Sculp.

It is fixed to the anterior parts of the transverse apophysis of the third, fourth, fifth, and sixth vertebræ in a digitated manner. From thence it runs obliquely inward toward the lateral parts of the bodies of the vertebræ, passes on the fore-side of the first and second, without being inserted in them; and, approaching gradually towards the same muscle on the other side, it is inserted near it in the fore-part of the lower side of the apophysis basilaris, or great apophysis of the os occipitis.

RECTUS ANTICUS BREVIS.

THIS is a small flat muscle, about the breadth of one finger, situated laterally on the anterior part of the body of the first vertebra. It is fixed below to the basis or root of the transverse apophysis of that vertebra, near the anterior eminence.

From thence it runs obliquely upward and inward to a transverse impression in the lower side of the apophysis basilaris of the occipital bone, immediately before the condyle on the same side, being covered by the rectus anticus longus.

TRANSVERSALIS ANTICUS PRIMUS.

THIS is a small, pretty thick, and wholly fleshy muscle, about the breadth of a finger, situated between the basis of the os occipitis and the transverse apophysis of the first vertebra. It is fixed by one end in the anterior part of that apophysis; and from thence running up a little obliquely, it is inserted, by the other end, in a particular impression, between the condyle of the os occipitis and the mastoid apophysis of the same side, behind the the apophysis styloides, and under the edge of the jugular fossula.

TRANSVERSALIS ANTICUS SECUNDUS.

THIS is a small muscle, situated between the transverse apophyses of the first two vertebræ of the neck. It is fixed, by one extremity, very near the middle of the second apophysis, and, by the other, near the root or basis of the first; and therefore it is a muscle of the neck, rather than of the head.

MUSCULI ACCESSORII.

WE sometimes meet with a small muscle, fixed, by one end, to the extremity of the first transverse apophysis of the neck, near the insertions of the two obliqui, from whence, running up obliquely, it is again inserted behind the mastoid apophysis. This muscle is commonly thought to be a third small transversalis on that side where it is found, but it seems rather to be an additional muscle to the obliquus superior.

USES *of the Muscles which move the Head on the Trunk.*

THE action of the sterno-mastoidæi is different, according as either both muscles, or only one of them, acts, and according to the different situation of the head and trunk.

When we keep the head and trunk streight, whether in standing or sitting, both muscles preserve the head in that posture against any force by which it would otherwise be moved backward.

One of these muscles acting alone, may have the same use, if the force to push the head back be applied between the anterior and lateral parts of it.

They both serve likewise to perform the rotations of the head, that is, to make it turn to either side as on a pivot; and, in this case, when we turn the head to one side, the sterno-mastoidæus on the other side acts, and not that on the same side.

They both serve, in the next place, to bring the head near the thorax when we lie on the back, or bend backward in sitting. In this case, the sternum, being the fixed point, must remain immoveable; but as its connection with the first rib, and the inflexibility of the cartilage of that rib, are not always sufficient for this, the musculi recti of the abdomen must lend their assistance in great efforts.

The two splenii serve to support the head in an erect posture, whether in standing or sitting; to moderate the flexion of the head forward, and to bring it back again to its natural posture.

They serve alternately to co-operate with either of the sterno-mastoidæi, for the rotation of the head: Thus when the right sterno-mastoidæus turns the head, the left splenius corresponds with it by its upper part; while the lower part at the same time turns the vertebræ of the neck.

The complexi are assistants to the splenii, to keep the head streight in sitting or standing, to hinder it from inclining forward, and to raise it when inclined.

The recti majores, and minores postici, and obliqui superiores, turn the head a little backward on the first vertebra of the neck. The recti majores contribute most to this motion; and the minores seem likewise to hinder the articular membranes from being pinched between the bones in great motions.

The recti majores and minores antici, and the two transversales antici, move the head forward on the first vertebra; and the recti minores, and transversales breves, likewise defend the capsular ligaments.

The obliqui inferiores or majores are true rotators of the head, by turning the first vertebra upon the odontoid apophysis of the second; all which alternate motions the head follows, without being hindered in the motions forward and backward in any degree of rotation.

Of the transversales antici, the first only move the head in the manner above mentioned; neither can they perform any other motions, their insertions being confined to the os occipitis and first vertebra. The transversales antici secundi have no share in the particular motions of the head, but ought rather to be ranked among the muscles which move the vertebræ of the neck.

The complexi minores belong to the head only by their superior portions; the other portions belonging rather to the neck. They may serve alternately in the lateral motions of the head, and thereby co-operate with the sple-

nius and sterno-mastoidæus of the same side, when these two act together; and they may likewise be of use to preserve the capsular ligaments to which they adhere.

The small accessorii, when they are found, have the same uses with the muscles to which they are supernumerary.

SECT. XV. *Of the Vertebral* MUSCLES.

LONGUS COLLI.

THIS vertebral muscle is made up of several others, situated laterally along the fore-side of all the vertebræ of the neck, and some of the upper vertebræ of the back.

It may be divided into two portions; one superior, consisting of oblique converging muscles; and one inferior, composed of oblique diverging muscles.

The superior portion is covered by the rectus anticus longus of the head. The muscles, of which it consists, are fixed below to all the transverse apophyses that lie between the first vertebra and the last. From thence they run up obliquely, and are inserted in the anterior eminence of the first vertebra, and in the bodies of the three following.

The inferior portion appears almost streight, and yet all the muscles that compose it are diverging, or directed obliquely outward. They are fixed below to the anterior lateral part of the body of the last vertebra of the neck, and of the first three of the back, and sometimes of more. From thence they run upward, and a little obliquely outward, and are inserted near the transverse apophyses of all the vertebræ of the neck, except the first and last.

TRANSVERSALIS COLLI MAJOR.

THIS is a long thin muscle, placed along all the transverse apophyses of the neck, and the four, five, or six upper apophyses of the back, between the complexus major and minor.

It is composed of several small muscular fasciculi, which run directly from one or more transverse apophyses, and are inserted sometimes in the apophysis nearest to these, sometimes in others more remote, the several fasciculi crossing each other between the insertions of the two complexi, which are likewise crossed by them.

TRANSVERSALIS GRACILIS *sive* COLLATERALIS COLLI.

THIS is a long thin muscle, resembling the transversalis major in every thing but size, and situated on the side of that muscle.

SEMI-SPINALIS *sive* TRANSVERSO-SPINALIS COLLI.

THIS name is given to all that fleshy mass which lies between the transverse and spinal apophyses, from the second vertebra of the neck, to the middle of the back.

It is composed of several oblique converging muscles, which may be divided into external and internal.

The external are fixed below to the transverse apophyses of the six, seven, eight, or nine upper vertebræ of the back, by tendinous extremities, which, as they ascend, become fleshy, and mix with each other. Their superior insertions in the neck are six in number, whereof the first, which is tendinous, is in the seventh spinal apophysis; the rest, which are fleshy, are in the five next spinal apophyses.

The internal are shorter and more oblique than the external, and partly covered by them. They are fixed, by their lower extremities, to the transverse apophyses of the three or four upper vertebræ of the back, and to the oblique apophyses of the four or five lower vertebræ of the neck; and, by their other extremities, they are inserted in the six spinal apophyses of the neck.

SPINALES COLLI MINORES.

THESE muscles lie between the six spinal apophyses of the neck, and between the last of the neck and first of the back, being inserted in these apophyses, by both extremities, on one side of the posterior cervical ligament, which parts them from those on the other side.

TRANSVERSALES COLLI MINORES.

THESE are very small short muscles, found in the interstices of several transverse apophyses in which they are inserted. They are likewise termed *inter-transversales*.

SACRO-LUMBARIS.

THIS is a long complex muscle, narrow and thin at the upper part, broad and thick at the lower, representing a kind of flat pyramid. It lies between the spine and posterior part of all the ribs, and along the back-part of the regio lumbaris, all the way to the os sacrum.

Through all this space, it is closely accompanied by the longissimus dorsi, which lies between it and the spinal apophyses of the vertebræ, a narrow, fatty, or cellular line running between them.

It is fixed below, by a broad thin tendinous aponeurosis, to the superior spines of the os sacrum, and to the neighbouring lateral parts of that bone; and, lastly, to the external labium of the posterior part of the crista ossis ilium, all the way to the great tuberosity.

From thence this muscle runs upward, and a little laterally, over all the regio lumbaris; the aponeurosis sending off, from its inside, a mass of fleshy fibres, which are divided, from below upwards, into several large fasciculi, inserted in all the transverse apophyses of the loins.

Afterwards it runs up obliquely over all the ribs, sometimes as high as the two or three lowest vertebræ of the neck, sometimes higher, and sometimes it ends at the first vertebra of the back.

LONGISSIMUS DORSI.

THIS is a very complex, long, and narrow muscle, something

ſomething like the ſacro-lumbaris, but more fleſhy and thicker, ſituated between the ſpinal apophyſes and the muſcle juſt mentioned, from which it is divided by a ſmall, fatty, or cellular line; but at the lower part they are confounded together. It covers the ſemi-ſpinalis, or tranſverſo-ſpinalis dorſi, and the ſemi-ſpinalis lumborum. Its upper part lies between the ſacro-lumbaris and tranſverſalis colli.

Its inferior inſertions are partly by diſtinct tendinous portions, and by a broad aponeuroſis common to it with the ſacro-lumbaris; and partly by a large faſciculi of fleſhy fibres, which, at firſt ſight, ſeem to compoſe one uniform maſs. It is fixed, by the long, flat, tendinous portions of different breadths, to the laſt ſpinal apophyſis of the back, to all thoſe of the loins, and to one or two of the ſuperior ſpines of the os ſacrum. Theſe portions lie at different diſtances from each other, but are all connected by a thin aponeuroſis fixed to their edges.

From thence they run up obliquely, diverging from the apophyſes; and, beginning to be fleſhy at their inner or anterior ſides, they terminate above in ſmall roundiſh tendons, inſerted in the extremities of the ſeven upper tranſverſe apophyſes of the back, and in the neighbouring-ligaments of all the true ribs.

The other inferior inſertion wholly fleſhy, is partly in the inner or foreſide of the aponeuroſis of the ſacro-lumbaris, and partly in the upper portion of the os ſacrum, being from thence continued to the great tuberoſity of the os illium.

From thence this uniform maſs of fleſhy fibres runs up in a courſe almoſt direct, croſſing the tendinous portions which are more oblique; and join the inferior fibres of the ſacro-lumbaris by large faſciculi inſerted in the tranſverſe and oblique apophyſes of the vertebræ of the loins. The fibres of this portion go afterwards to the ribs, being inſerted by planes more or leſs fleſhy, in the lower convex edge of all the falſe ribs, between the condyles or tuberoſities and the angles.

At the ſixth or ſeventh vertebra of the back, one or more of the tendinous portions often communicate with ſome faſciculi of the ſemi-ſpinalis, or tranſverſo-ſpinalis dorſi.

SPINALIS DORSI MAJOR.

This is a pretty long and ſlender muſcle, lying upon the lateral part of the extremities of the ſpinal apophyſis of the back.

It is compoſed of ſeveral muſcular faſciculi of different lengths, which, croſſing each other, are inſerted laterally by ſmall tendons in the ſpinal apophyſes from the ſecond, third, or fourth vertebra of the back; and ſometimes, though ſeldom, from the laſt of the neck, or firſt of the back, all the way to the firſt or ſecond vertebra of the loins, with ſeveral irregular decuſſations, which vary in different ſubjects.

SPINALES DORSI MINORES.

These muſcles are of two kinds. Some go laterally from the extremity of one ſpinal apophyſis to another; being often mixed with the ſhort faſciculi of the ſpinalis major. The reſt lie directly between the extremities of two neighbouring ſpinal apophyſes, being ſeparated from their fellows on the other ſide by the ſpinal ligament. They are ſmaller and thinner than thoſe of the neck, and are properly enough termed *inter-ſpinales*.

TRANSVERSALES DORSI MINORES.

Some particular muſcles of this kind are found fixed to the extremities of the three loweſt tranſverſe apophyſes of the back. The reſt are all in ſome meaſure continuations of the tranſverſalis major.

Semi-Spinalis *ſive* Transverso-Spinalis Dorsi.

This is a fleſhy maſs, which, from all the ſpinal and tranſverſe apophyſes of the back and loins, is extended into diſtinct faſciculi over the vertebræ themſelves.

It is made up, like that of the neck, of ſeveral oblique converging vertebral muſcles, the uppermoſt of which is fixed below to the third tranſverſe apophyſis of the back, and above to the firſt ſpinal apophyſis. The loweſt is fixed below to the third tranſverſe apophyſis of the loins, and above to the laſt ſpinal apophyſis of the back.

They may be divided into external, which are firſt diſcovered; and internal, which lie immediately on the vertebræ. The external, from the firſt vertebra to the ſeventh, incluſively, appear to be longer than the internal, which are covered by them.

Transverso-Spinalis Lumborum, Sacer Veteribus.

This muſcle is compoſed of ſeveral oblique converging of tranſverſo-ſpinal muſcles, in the ſame manner as in the back and neck; and it lies between the ſpinal and oblique apophyſes of the loins, reaching to the os ſacrum.

The loweſt of theſe muſcles are fixed to the ſuperior lateral parts of the os ſacrum, to the ligamentum ſacro-iliacum, and to the poſterior ſuperior ſpine of the os ilium. The reſt are fixed to the three loweſt tranſverſe apophyſes, and to the four loweſt oblique apophyſes of the loins, and to their lateral tuberoſities. From thence they run up to all the ſpinal apophyſes of theſe vertebræ, the external, or thoſe that appear firſt, being longer than the internal, which lie immediately on the vertebræ, eſpecially toward the lower part.

Spinales & Transversales Lumborum.

There are ſome faſciculi which run up from the ſuperior falſe ſpines of the os ſacrum, to the lower ſpinal apophyſes of the loins, which may be looked upon as ſo many ſpinales lumborum majores. There are likewiſe ſome ſpinales minores between the ſpinal apophyſes of the loins, and tranſverſales minores between the tranſverſe apophyſes, which are ſometimes of a conſiderable breadth.

Quadratus Lumborum *five* Lumbaris Externus.

This is a ſmall, oblong, flat muſcle, irregularly ſquare, narrower at its upper than at its lower part, lying along the ſides of the vertebræ lumborum, between the laſt falſe rib and the os ilium.

It is fixed below to the external labium of almoſt all the poſterior half of the criſta oſſis ilium, to the ligamentum ſacro-iliacum, and a little to the os ſacrum, by a fleſhy plane, the fibres whereof run obliquely backward.

From thence it runs up between the ſacro-lumbaris and pſoas, by both which it is partly hid, and is inſerted in the extremities of all the tranſverſe apophyſes of the loins by oblique tendinous digitations. It is likewiſe fixed by a broad inſertion in the twelfth rib, on the inſide of the ligament that lies between it and the longiſſimus dorſi, by which that rib is connected to the firſt vertebra of the loins.

MUSCULI OSSIS COCCYGIS.

These are ſmall, thin, radiated muſcles, lying on the inner or concave ſide of the os ſacrum, and neighbouring parts of the pelvis. They are four in number, two on each ſide, whereof one is placed more forward, the other more backward; for which reaſon the firſt may be termed *coccygæus anterior, ſive iſchio-coccygæus*; the other *coccygæus poſterior, ſive ſacro-coccygæus*.

The coccygæus anterior is fixed by a broad inſertion in the anterior portion of the ſmall tranſverſe ligament, at the upper part of the foramen ovale of the os innominatum, which is no more than a particular fold of the great tranſverſe ligament of the pelvis. From thence it runs between this great ligament and the muſculus obturator internus, and, contracting in breadth, it is inſerted in the lower part of the os coccygis.

The coccygæus poſterior, or ſacro-coccygæus, is fixed to the inner or concave edge of the two firſt vertebræ of the os ſacrum, to the inner and lower edge of the ligamentum ſacro-ſciaticum, and to the ſpine of the os iſchium. From thence, contracting in breadth, it is inſerted in the inſide of the os coccygis above the former muſcle.

PSOAS PARVUS.

This is a long ſlender muſcle, lying upon the pſoas major.

It is fixed above by a ſhort tendon, ſometimes to the laſt tranſverſe apophyſis of the back, or higher; ſometimes to the firſt of the loins, and ſometimes to both. From thence it runs down wholly fleſhy, and more or leſs complex, on the great pſoas, in a direction a little oblique.

Having reached the middle of the regio-lumbaris, or thereabouts, it forms a ſlender flat tendon, which gradually increaſing in breadth, like a thin aponeuroſis, runs over the pſoas major and iliacus internus, at their union, and from thence down to the ſymphyſis of the os pubis and os ilium, and is inſerted chiefly in the criſta of the os pubis, above the inſertion of the pectineus, ſometimes ſending an aponeurotic lamina further down.

Uses *of the Muſcles which move the Vertebræ.*

The ſcaleni, when they act on each ſide at the ſame time, may aſſiſt in bringing the neck forward, when we lean back in any reſpect. When thoſe of one ſide act by themſelves, they make a lateral inflection, either of all the vertebræ of the neck together, as in bending the middle of the neck; or of ſome only, as in bending the lower part of the neck alone.

The longi colli bring the neck forward by the lower part of their inferior portions. When one of them acts alone, or acts more than the other, this motion is more or leſs oblique.

By the upper and greateſt part of the loweſt portion, they counterbalance the poſterior muſcles of theſe vertebræ, and hinder the neck from bending backward by the contraction of the ſterno-maſtoidæi, when, lying on the back, we raiſe the head.

The tranſverſalis major, tranſverſalis gracilis, and the little tranſverſales, acting on one ſide, can have no other uſe but to bend the neck laterally, and to hinder theſe inflexions when they act on both ſides.

The ſemi-ſpinales or tranſverſo-ſpinales of both ſides acting together, extend the neck upon the trunk, to keep it from inclining forward in ſtanding or ſitting, and bend it backward. The ſemi-ſpinales of one ſide acting alone, produce the ſame motions in an oblique direction; and in that caſe they are aſſiſted by the inferior or vertebral portion of the neighbouring ſplenius, under which they croſs.

The ſemi-ſpinales of both ſides may likewiſe ſerve for the rotation of the neck, but then the inferior ſplenius of the oppoſite ſide muſt aſſiſt them.

The inter-ſpinales are aſſiſtants to the ſemi-ſpinales in their mutual action, and may likewiſe ſerve to bring back the neck to its natural ſituation, after ſmall motions of rotation.

The vertebræ of the back are moved by being bent forward, by being extended or ſtraightened, and by being inflected directly or obliquely toward each ſide. The motion of rotation has no place here, becauſe of the particular ſtructure of the joints of theſe vertebræ, and their connexion with the ribs, which likewiſe hinder the flexion backward. Flexion and extenſion are the two principal motions, and much more apparent than the others.

The flexion of the back forward is not performed by any particular muſcles, but depends, both in ſtanding and ſitting, on the relaxation of the muſcles that extend or ſtraighten it, and keep it in that erect poſture.

The two ſacro-lumbares maintain the back and the regio-lumbaris in their natural ſituation when we ſtand or ſit; and by the relaxation of their fibres more or leſs, the trunk is proportionably bent forward by the weight of the head and breaſt. They likewiſe extend the back and loins in all poſtures, keep them ſteady and fixed under the weight of burdens, and bend the loins backward.

The longiſſimus dorſi is an aſſiſtant to the ſacro-lumbaris, eſpecially to the vertebral portion of that muſcle, which it helps very powerfully, both by the multiplicity and inſertion of its fibres, in ſuſtaining the vertebræ of the

the back and loins while extended, whether in ſitting or ſtanding, and in preventing their ſinking under the weight of the body, or of any additional burden. It aſſiſts in performing and in counterbalancing all the motions and inflexions of which theſe vertebræ, eſpecially thoſe of the loins, are capable in all poſtures of the body.

All the ſpinales and tranſverſales of the back and loins belonging to the claſs of the vertebrales recti, the ſpinales to the middle muſcles, and the tranſverſales to the lateral, their chief uſes muſt be to aſſiſt, moderate, and maintain the motions of extenſion and lateral inflexion, whether ſimple and direct, or oblique and compound.

The ſemi-ſpinales, or tranſverſo-ſpinales, being oblique, converging, vertebral muſcles, are aſſiſtants to the ſacro-lumbaris and longiſſimus dorſi, which they croſs on each ſide.

The quadratus lumborum and pſoas parvus are of the ſame uſe to the vertebræ of the loins, as the ſcaleni to thoſe of the neck. When both quadrati act, they keep the lumbar pillar ſtraight, that is, ſo as not to incline to either ſide, and then they may aſſiſt the recti of the abdomen in the inflexions forward, and the ſuperior portions of the obliqui in lateral inflexions.

They may likewiſe ſerve to ſupport the haunches alternately in walking; and, in ſtanding on one foot, the quadratus of the oppoſite ſide may ſupport the haunch of that ſide.

The pſoas parvus, ſerves to ſuſtain the pelvis much in the ſame manner with the muſculi recti of the abdomen, in climbing, &c.

The coccygæus anterior may ſuſtain the coccyx in æquilibrio, and hinder it from being bent backward, and from being luxated in great ſtrains, as in the excretion of hardened fæces, &c.

The coccygæus poſterior can only ſerve to replace the os coccygis when it has been forced backward, and to hinder it from being luxated backward.

Sect. XVI. *The* Muscles *which move the Lower Jaw.*

MASSETER.

This is a very thick fleſhy muſcle, ſituated at the back part of the cheek. It ſeems to be made up of three portions, like a triceps, *viz.* one large and external portion, one middle, and one ſmall and internal.

The external portion is fixed by one tendinous extremity to all the inferior edge of the os malæ, and a little to the neighbouring parts of the os maxillare and apophyſis zygomatica of the os temporum. From thence it runs down obliquely backward, being wholly fleſhy, and is inſerted by the other extremity in the rough impreſſion on the outſide of the angle of the lower jaw.

The middle portion is fixed by one end to the lower edge of the whole apophyſis zygomatica of the os temporum, and a very little to that of the os malæ. From thence it runs down a little obliquely forward in an oppoſite direction to the firſt portion, under which it croſſes, and is inſerted by its other extremity in the middle of the inſide of the ramus of the lower jaw, near the inſertion of the external portion with which it mixes.

The third portion, which is leaſt and moſt internal, is fixed by one extremity to the inner labium of the lower edge, and alſo to the inſide of almoſt all the zygomatic arch; and by the other, to the root or baſis of the coronoid apophyſis, where it mixes wholly fleſhy with the inſertion of the middle portion.

TEMPORALIS.

This is a broad flat muſcle, reſembling the quadrant of a circle in figure. It occupies all the ſemi-circular or ſemi-oval plane of the lateral region of the cranium, the temporal foſſa, and part of the zygomatic foſſa. From this ſituation it has its name.

To conceive juſtly the inſertions of this muſcle, it muſt be obſerved, that the pericranium is divided into two laminæ. The internal lamina, ſometimes taken for a particular perioſteum, covers immediately all the bony parts of this region. The external lamina ſeparated from the other, is ſpread out like an aponeurotic or ligamentary tent, by means of its adheſions to the external angular apophyſis of the os frontis, to the poſterior edge of the ſuperior apophyſis of the os malæ, and to the upper edge of all the zygomatic arch, all the way to the root of the maſtoid apophyſis.

This muſcle is compoſed of two planes of fleſhy fibres, fixed to the two ſides of a tendinous plane nearly of the ſame breadth with them, like a concealed middle tendon; as may be plainly ſeen by dividing the muſcle all the way to the bone, according to the direction of its fibres. The body of the muſcle thus formed is incloſed between the two aponeurotic or ligamentary laminæ in the following manner.

The internal fleſhy plane is fixed, by a broad radiated inſertion, to all the ſemi-circular plane of the cranium, by the intervention of the internal lamina of the perioſteum.

Thus it is fixed to the lateral external part of the os frontis, and to its external angular apophyſis, to the lower part of the os parietale, to the ſquamous portion of the os temporis, to the great ala or temporal apophyſis of the ſphenoidal bone, by which the temporal foſſa is formed; and a little to the backſide of the internal orbitary apophyſis of the os malæ, which forms part of the zygomatic foſſa.

PTERYGOIDÆUS MAJOR *ſive* INTERNUS.

This muſcle lies on the inſide of the lower jaw, almoſt in the ſame manner as the maſſeter does on the outſide, being of the ſame figure with that muſcle, only ſmaller and narrower.

It is fixed above in the pterygoid cavity, chiefly to the inſide of the external ala of the apophyſis pterygoides.

It runs down obliquely toward the angle of the lower jaw, and is inſerted a little tendinous in the inequali-

ties on the inside thereof, opposite to the insertion of the masseter.

PTERYGOIDÆUS MINOR *sive* EXTERNUS.

This is an oblong fleshy muscle, much smaller than the other, and situated almost horizontally between the outside of the apophysis pterygoides, and the condyloid apophysis of the lower jaw, the subject being considered in an erect posture.

It is fixed by one extremity to the outside and edge of the outer ala of the pterygoid apophysis, filling the fossula which is at the basis of this apophysis, near the basis of the temporal apophysis, of the sphenoidal bone.

From thence it runs backward, and a little outward, into the void space between the two apophyses of the lower jaw, and is inserted anteriorly in the condyloid apophysis, at a small fossula immediately under the inner angle of the condyle. It is also fixed to the capsular ligament of the joint.

DIGASTRICUS.

This is a small long muscle, situated laterally between the whole basis of the jaw and the throat. It is fleshy at both extremities, and tendinous in the middle, as if it consisted of two small muscles joined endwise by a tendon, and from thence it is called *digastricus* in Greek, and *biventer* in Latin.

It is fixed by one fleshy extremity in the sulcus of the mastoid apophysis. From thence it runs forward, inclining towards the os hyoides, where the first fleshy body ends in a round tendon, which is connected to the lateral part and root of the cornua of that bone by a kind of aponeurotic ligament, and not by a vagina or pulley.

Here the tendon is incurvated, and presently ends in the other fleshy body, which is fixed immediately above the internal labium of the basis of the chin near the symphysis, in a small unequal depression. This insertion is broader than that of the other extremity.

Uses *of the Muscles which move the Lower Jaw.*

The two temporales acting together, raise the lower jaw, press the teeth in that jaw against the upper teeth, and pull it back when it has been carried so far forward as that the lower incisores get before the upper. They perform the last motion by their most posterior portion, which passes over the root of the zygomatic apophysis, and the other motions by the co-operation of all their muscular radii.

The two masseters serve to raise the lower jaw, and to push the lower teeth against the upper, in which use they co-operate with the temporales. They likewise bring this jaw forward by their external and largest portion; draw it back by their middle portion; and move it laterally by their superior portions acting alternately. By the co-operation of all the three portions, they press the lower teeth against the upper.

Both pterygoidæi interni serve to raise the lower jaw, to bring the lower teeth near the upper, and to move the jaw laterally, as in grinding the food.

The two pterygoidæi externi bring the lower jaw forward, in order to set the lower incisores before the upper; in which action they are antagonists to the posterior portion of the temporales, and the great portion of the masseters. When one of them acts, it carries the chin obliquely forward, or turns it toward the other sides. This oblique motion is performed alternately by these two muscles acting singly.

The two digastrici serve to depress the lower jaw, and to open the mouth.

The force of these muscles is very considerable, as may be shewn by laying the elbow on a table, and leaning with the chin on the hand, while we endeavour at the same time to depress the lower jaw; for as in that case this jaw cannot descend, the digastrici, by their insertions in the apophysis mastoidæa, raise the upper jaw, by bending the head backward on the condyles of the lower jaw.

Sect. XVII. *The* Muscles *which move the Os Hyoides.*

MYLO-HYOIDÆUS.

This is a broad, thin, penniform muscle, situated transversely between the internal lateral parts of the basis of the lower jaw, and lying on the anterior portions of the two digastric muscles.

It is made up of two equal fleshy portions, one lying on the right side, the other on the left, both in the same plane, and joined to a small middle tendon, which is inserted anteriorly in the middle of the basis of the os hyoides, and from thence runs directly forward, diminishing gradually in its course.

Each portion is fixed, by fleshy fibres, to the internal lateral part of the lower jaw, between the oblique prominent line and the basis, under the first four dentes molares and caninus. The anterior and greatest part of the other fibres of each portion run obliquely from before backward, to the middle tendon, in which they are regularly fixed, the anterior fibres being the shortest, and a small triangular void space being formed between them and the symphysis of the chin.

The posterior fibres of each portion, which make about a fourth part of the whole, run likewise on each side to the basis of the os hyoides, and are inserted along the lower edge of its anterior or convex side, and from thence a little upward.

GENIO-HYOIDÆUS.

This is a small and pretty long fleshy muscle, situated between the symphysis of the chin and the os hyoides, close by its fellow.

It is fixed, by its anterior extremity, to a rough, and sometimes prominent surface, on the inner or posterior side of the symphysis of the lower jaw, a little above the chin. From thence it runs backward, and is inserted anteriorly in the upper edge of the basis of the os hyoides,

des, having firſt ſent off a ſmall lateral portion, which is fixed a little higher to the root of the cornu.

STYLO-HYOIDÆUS.

THIS is a ſmall fleſhy muſcle, lying obliquely between the apophyſis ſtyloides and os hyoides.

It is fixed laterally, by one extremity, to the root or baſis of the apophyſis ſtyloides, and, by the other, to the os hyoides, at the place where the baſis and cornu unite, and likewiſe to the cornu itſelf, from whence it has been called *ſtylo-cerato-hyoidæus.*

OMOPLATO-HYOIDÆUS *ſive* OMO-HYOIDÆUS *vulgo* CORACO-HYOIDÆUS.

THIS is a very long ſmall muſcle, much narrower than the ſterno-hyoidæus, and ſituated obliquely on the ſide of the neck or throat, between the ſcapula and os hyoides.

It is commonly fixed, by the lower extremity, to the ſuperior coſta of the ſcapula, between the ſmall notch and the angle, and ſometimes very near the angle.

From thence it paſſes over the coracoid apophyſis, adhering ſometimes to it by a kind of aponeuroſis, or membranous ligament, and from this adheſion the name of *coraco-hyoidæus* was given it by ſome who had not diſcovered its main inſertion.

It is likewiſe often fixed to the clavicula by ligamentary or fleſhy fibres; and has ſometimes been ſeen inſerted in the whole middle portion of that bone, being inſeparably united with the ſterno-hyoidæus.

Having paſſed the clavicle, it is bent forward, and runs between the ſterno-maſtoidæus and internal jugular vein, the ſmall middle tendon being ſituated in this place. From thence it runs up to its inſertion in the inferior lateral part of the baſis of the os hyoides, near the cornu, and inſertion of the ſterno-hyoidæus, which it covers a little.

STERNO-HYOIDÆUS *ſive* STERNO-CLEIDO-HYOIDÆUS.

THIS is a long, thin, flat muſcle, broader at the lower than at the upper part, and ſituated, together with its fellow, on the fore-ſide of the throat.

It is fixed, by its lower extremity, in the ſuperior and lateral part of the inner or poſterior ſide of the ſternum, in the poſterior part of the ſternal extremity of the clavicula, in the tranſverſe ligament which connects theſe two bones, and in the inner or back-ſide of the cartilage of the firſt rib. All theſe other inſertions are more conſiderable than that in the ſternum, which is ſometimes ſcarce perceivable.

From thence it runs up on the fore-ſide of the aſpera arteria, joined to its fellow by a membrane, which forms a ſort of linea alba, and is inſerted laterally in the lower edge of the baſis of the os hyoides.

USES *of the Muſcles which move the Os Hyoides.*

THE mechaniſm obſerved in the motions of the os hyoides, as well as in thoſe of the ſcapula, is very particular, and very different from what we find in all the other bones of the human body. All theſe bones have ſolid fulcra, on which they are either moved or kept fixed by the proper muſcles, after the manner of a lever or otherwiſe; whereas the os hyoides is merely ſuſpended, having nothing to fix it but theſe very muſcles which move it in different manners.

The mylo-hyoidæus repreſents a moveable floor or bed, which ſuſtains the tongue with its muſcles and glands, and forms the bottom of the cavity of the mouth. When the two portions of this muſcle act together, they draw the os hyoides a little forward, and fix it in that ſituation, raiſing the whole tongue at the ſame time, and compreſſing the glandulæ ſub-linguales. If one lateral portion acts more than the other, it puts the os hyoides in an oblique ſituation, and in a condition to ſerve as a fixed point for the motions of the tongue.

The genio hyoidei pull the os hyoides much more forward than the mylo-hyoideus; and as they are very narrow, and cloſely united together, there ſeems to be very little occaſion for one of them to act without the other.

The ſtylo-hyoidæi move the os hyoides upward and backward in a middle direction, between thoſe in which they lie; and they draw it more upward and backward when they act freely; that is, without being checked or confined by other muſcles, in the manner which we ſhall ſee hereafter. When one acts more than the other, the bone is moved obliquely.

The omo-hyoidæi, or coraco-hyoidæi, act as the ſtylo-hyoidæi, in a middle direction between the oblique directions in which they lie, and draw the os hyoides downward and backward, when they are not counterbalanced by the ſtylo-hyoidæi. When one acts more than the other, the bone is drawn obliquely to the right or left hand.

When theſe muſcles and the ſtylo-hyoidæi act together, the os hyoides is drawn backward by a direct motion compounded of four oblique motions. This compound motion is directed more upward or more laterally, according to the degree of action of the ſtylo-hyoidæi, or omo-hyoidæi, or of any one muſcle of each pair; and in all theſe motions the four muſcles are counterbalanced by the genio-hyoidæi.

The ſterno-hyoidæi draw the os hyoides directly downward, and ſerve to counterbalance the different motions of the ſtylo-hyoidæi, omo-hyoidæi, and genio-hyoidæi. They may, in ſome caſes, be aſſiſted by the ſterno-thyroidæi, and thyro-hyoidæi, as we ſhall ſee hereafter.

According to the method commonly obſerved in complete treatiſes of myology, the following muſcles remain ſtill to be deſcribed, *viz.* The muſcles of the forehead, occiput, palpebræ, eye, external ear, noſe, lips, tongue, uvula, ductus Euſtachianus, pharynx, larynx, parts of generation, anus, and bladder; and to theſe we ought even to add the heart, as Mr Cowper has done in the late edition of his Myotomy. But the deſcription of theſe will be better underſtood when we treat of the parts to which they belong. See Part VI.

EXPLA-

EXPLANATION OF PLATE XV.

Fig. 1. The Muscles immediately under the common teguments on the anterior part of the body, are repreſented on the right ſide; and on the left ſide the Muscles are ſeen which come in view when the exterior ones are taken away.

A, The frontal muſcle. B, The tendinous aponeuroſis which joins it to the occipital; hence both named *occipito-frontalis*. C, Attolens aurem. D, The ear. E, Anterior auris. F F, Orbicularis palpebrarum. G, Levator labii ſuperioris alæque naſi. H, Levator labiorum communis. I, Zygomaticus minor. K, Zygomaticus major. L, Maſſeter. M, Orbicularis labiorum. N, Depreſſor labii inferioris. O, Depreſſor labiorum communis. P, Buccinator. Q Q, Platyſma myoides. R R, Sterno-cleido maſtoidæus. S, Part of the trapezius. T, Part of the ſcaleni.

Superior Extremity.—U, Deltoides. V, Pectoralis major. W, Part of the latiſſimus dorſi. X X, Biceps flexor cubiti. Y Y, Part of the brachiæus externus. Z Z, The beginning of the tendinous aponeuroſis, (from the biceps) which is ſpread over the muſcles of the fore-arm. a a, Its ſtrong tendon inſerted into the tubercle of the radius. b b, Part of the brachiæus internus. c, Pronator teres. d, Flexor carpi radialis. e, Part of the flexor carpi ulnaris. f, Palmaris longus. g, Aponeuroſis palmaris. 3, Palmaris brevis. 1, Ligamentum carpi annulare. 2 2, Abductor minimi digiti. h, Supinator longus. i, The tendons of the three extenſors of the thumb. k, Abductor pollicis. l, Flexor pollicis longus. m m, The tendons of the flexores digitorum communi.—The ſheaths are entire in the right hand,—in the left cut open, to ſhew the tendons of the flexor profundus perforating the ſublimis.

Muscles not referred to—in the left ſuperior extremity.—n, Pectoralis minor, ſeu ſerratus anticus minor. o, The two heads of (x x) the biceps. p, Coraco-brachialis. q q, The long head of the triceps extenſor cubiti. r r, Teres major. ſ ſ, Subſcapularis. t t, Extenſores radiales. u, Supinator brevis. v, The cut extremity of the pronator teres. w, Flexor digitorum ſublimis. x, Part of the flexor profundus. y, Flexor pollicis longus. z, Part of the flexor pollicis brevis. 4, Abductor minimi digiti. 5, The four lumbricales.

Trunk.—6, Serrated extremities of the ſerratus anticus major. 7 7, Obliquus externus abdominis. 8 8, The linea alba. 9, The umbilicus. 10, Pyramidalis. 11 11, The ſpermatic cord. On the left ſide, it is covered by the cremaſter. 12 12, Rectus abdominis. 13, Obliquus internus. 14 14, &c. Intercoſtal muſcles.

Inferior Extremities.—*a a*, The gracilis. *b b*, Parts of the triceps. *c c*, Pectincus. *d d*, Pſoas magnus. *e e*, Iliacus internus. *f*, Part of the glutæus medius. *g*, Part of the glutæus minimus. *h*, Cut extremity of the rectus cruris. *i i*, Vaſtus externus. *k*, Tendon of the rectus cruris. *l l*, Vaſtus internus. * Sartorius muſcle. * * Fleſhy origin of the tenſor vaginæ femoris or membranoſus. Its tendinous aponeuroſis covers (*i*), the vaſtus externus in the right-ſide. *m m*, Patella. *n n*, Ligament or tendon from it to the tibia. *o*, Rectus cruris. *p*, Crureus. *q q*, The tibia. *r r*, Part of the gemellus or gaſtrocnemius externus. *ſ ſ ſ*, Part of the ſoleus or gaſtrocnemius internus. *t*, Tibialis anticus. *u*, Tibialis poſticus. *v v*, Peronæi muſcles. *w w*, Extenſor digitorum longus communis. *x x*, Extenſor pollicis longus. *y*, Abductor pollicis.

Fig 2. The Muscles, Glands, &c. of the left ſide of the face and neck, after the common teguments and platyſma myoides have been taken off.

a, The frontal muſcle. b, Temporalis and temporal artery. c, Orbicularis palpebrarum. d, Levator labii ſuperioris proprius. e, Levator labiorum communis. f, Zygomaticus. g, Depreſſor labii inferioris proprius. h, Depreſſor labiorum communis. i, Buccinator. k, Maſſeter. l l, Parotid gland. m, Its duct. n, Sterno-cleido maſtoides. o, Part of the trapezius. p, Sterno-hyoidæus. q, Sterno-thyroidæus. r, Omo-hyoidæus. ſ, Levator ſcapulæ. t t, Scaleni. u, Part of the ſplenius.

Fig. 3. The Muscles of the face and neck, in view after the exterior ones are taken away.

a a, Corrugator ſuperciliorum. b, Temporalis. c, Tendon of the levator palpebræ ſuperioris. d, Tendon of the orbicularis palpebrarum. e, Maſſeter. f, Buccinator. g, Levator labiorum communis. h, Depreſſor labii ſuperioris proprius. i, Sphincter oris. k, Depreſſor labiorum communis. l, Muſcles of the os hyoides. m, Sterno-cleido maſtoideus.

Fig. 4. Some of the Muscles of the os hyoides, and ſubmaxillary gland.

a, Part of the maſſeter muſcle. b, Poſterior head of the digraſtic. c, Its anterior head. d d, Sterno-hyoidæus. e, Omo-hyoidæus. f, Stylo-hyoidæus. g, Submaxillary gland in ſitu.

Fig. 5. The ſubmaxillary gland and duct.

a, Muſculus mylo-hyoidæus. b, Hyo-gloſſus. c, ſubmaxillary gland extra ſitu. d, Its duct.

EXPLA-

EXPLANATION OF PLATE XVI.

FIG. 1. The MUSCLES immediately under the common teguments on the posterior part of the body are represented in the right side;—and on the left side the MUSCLES are seen which come in view when the exterior ones are taken away.

HEAD.—A A, Occipito-frontalis. B, Attollens aurem. C, Part of the orbicularis palpebrarum. D, Masseter. E, Pterygoidæus internus.

TRUNK.—Right side. F F F, Trapezius seu cucullaris. G G G G, Latissimus dorsi. H, Part of the obliquus externus abdominis.

TRUNK.—Left side. I, Splenius. K, Part of the complexus. L, Levator scapulæ. M, Rhomboides. N N, Serratus posticus inferior. O, Part of the longissimus dorsi. P, Part of the sacro-lumbaris. Q, Part of the semi-spinalis dorsi. R, Part of the serratus anticus major. S, Part of the obliquus internus abdominis.

SUPERIOR EXTREMITY.—Right side. T, Deltoides. U, Triceps extensor cubiti. V. Supinator longus. W W, Extensores carpi radialis longior & brevior. X X, Extensor carpi ulnaris. Y Y, Extensor digitorum communis. Z, Abductor indicis. 1 2 3, Extensores pollicis.

SUPERIOR EXTREMITY.—Left side. a, Supra-spinatus. b, Infra-spinatus. c, Teres minor. d, Teres major. e, Triceps extensor cubiti. f f, Extensores carpi radialis. g, Supinator brevis. h, Indicator. 1 2 3, Extensores pollicis. i, Abductor minimi digiti. k, Interossei.

INFERIOR EXTREMITY.—Right side. l, Glutæus maximus. m, Part of the glutæus medius. n, Fascialis. o, Gracilis. p p, Adductor femoris magnus. q, Part of the vastus internus. r, Semimembranosus. s, Semitendinosus. t, Long head of the biceps flexor cruris. u u, Gastrocnemius externus seu gemellus. v, Tendo Achillis. w, Soleus seu gastrocnemius internus. x x, Peronæus longus & brevis. y, Tendons of the flexor digitorum longus;—and under them * flexor digitorum brevis. z, Abductor minimi digiti.

INFERIOR EXTREMITY.—Left side. *m*, *n*, *o*, *p p*, *q*, *r*, *s*, *t*, *v*, *w w*, *x x*, *y*, *z*. Point the same parts as in the right side. *a*, Pyriformis. *b b*, Gemini. *c c*, Obturator internus. *d*, Quadratus femoris. *e*, Coccygæus. *f*, The short head of the biceps flexor cruris. *g g*, Plantaris. *h*, Poplitæus. *i*, Flexor pollicis longus.

FIG. 2. The palm of the left hand after the common teguments are removed, to shew the MUSCLES of the fingers.

a, Tendon of the flexor carpi radialis. b, Tendon of the flexor carpi ulnaris. c, Tendons of the flexores digitorum. d, Abductor pollicis. e e, Flexor pollicis longus. f, Flexor pollicis brevis. g, Palmaris brevis. h, Abductor minimi digiti. i, Ligamentum carpi annulare. k, A probe put under the tendons of the flexor digitorum sublimis; which are perforated by l, the flexor digitorum profundus. m m m m, Lumbricales. n, Adductor pollicis.

FIG. 3. A fore-view of the foot and tendons of the flexores digitorum.

a, Cut extremity of the tendo Achillis. b, Upper part of the astragalus. c, Os calcis. d, Tendon of the tibialis anticus. e, Tendon of the extensor pollicis longus. f, Tendon of the peronæus brevis. g, Tendons of the flexor digitorum longus, with the nonus Vesalii. h h, The whole of the flexor digitorum brevis.

FIG. 4. MUSCLES of the Anus.

a a, An outline of the buttocks, and upper part of the thighs. b, The testes contained in the scrotum. c c, Sphincter ani. d, Anus. e, Levator ani. f f, Erector penis. g g, Accelerator urinæ. h, Corpus cavernosum urethræ.

FIG. 5. MUSCLES of the Penis.

a a, b, d, e e, f f, h, point the same as in fig. 4. c, Sphincter internus ani. g g, Transversus perinæi.

P A R T III.

OF THE ARTERIES.

THE heart throws the blood into two great arteries; one of which is named *aörta*, the other *arteria pulmonalis*.

The aorta distributes the blood to all the parts of the body, for the nourishment of the parts, and for the secretion of different fluids.

The arteria pulmonalis carries the venal blood through all the capillary veſſels of the lungs.

Both theſe great or general arteries are ſubdivided into ſeveral branches, and into a great number of ramifications. In this part, we ſhall deſcribe the diſtributions of the aorta, leaving the pulmonary artery to the particular hiſtory of the lungs. See Part VI.

The baſis of the heart being very much inclined to the right ſide, and turned a little backward, the aorta goes out from it in a direct courſe, nearly over-againſt the fourth vertebra of the back. Its courſe is direct with reſpect to the heart; but with reſpect to all the reſt of the body, it aſcends obliquely from the left to the right hand, and from before backward.

Soon after this, it bends obliquely from the right hand to the left, and from before backward, reaching as high as the ſecond vertebra of the back; from whence it runs down again in the ſame direction, forming an oblique arch. The middle of this arch is almoſt oppoſite to the right ſide or edge of the ſuperior portion of the ſternum, between the cartilaginous extremities or ſternal articulations of the firſt two ribs.

From thence the aorta deſcends in a direct courſe along the anterior part of the vertebræ, all the way to the os ſacrum, lying a little toward the left hand; and there it terminates in two ſubordinate or collateral trunks, called arteriæ iliacæ.

The aorta is by anatomiſts generally divided into the aorta aſcendens and aorta deſcendens, though both are but one and the ſame trunk. It is termed *aſcendens*, from where it leaves the heart to the extremity of the great curvature or arch. The remaining part of this trunk from the arch to the os ſacrum or bifurcation, already mentioned, is named *deſcendens*.

The aorta deſcendens is further divided into the ſuperior and inferior portions; the firſt taking in all that lies above the diaphragm; the other all that lies between the diaphragm and the bifurcation.

The aorta aſcendens is chiefly diſtributed to part of the thorax, to the head and upper extremities. The ſuperior portion of the aorta deſcendens furniſhes the reſt of the thorax; the inferior portion furniſhes the abdomen and lower extremities.

The great trunk of the aorta, through its whole length, ſends off immediately ſeveral branches, which are afterwards differently ramified; and theſe arterial branches may be looked upon as ſo many trunks with reſpect to the other ramifications, which again may be conſidered as ſmall trunks with regard to the ramifications that they ſend off.

The branches which go out immediately from the trunk of the aorta, may be termed original or capital branches; and of theſe ſome are large and others very ſmall.

The large capital branches of the aorta are theſe: two arteriæ ſubclaviæ, two carotides, one cæliaca, one meſenterica ſuperior, two renales, formerly termed emulgents, one meſenterica inferior, and two iliacæ.

The ſmall capital branches are chiefly the arteriæ coronariæ cordis, bronchiales, œſophagææ, intercoſtales, diaphragmaticæ inferiores, ſpermaticæ, lumbares, and ſacræ.

Theſe capital branches or arteries are for the moſt part diſpoſed in pairs; there being none in odd numbers but the cæliaca, the two menſentericæ, ſome of the œſophagææ, the bronchialis, and ſometimes the ſacræ.

The aorta gives riſe to two ſmall arteries, called coronariæ cordis, which go to the heart and its auricles; one of which is ſituated anteriorly, the other poſteriorly, and ſometimes they are three in number.

From the upper part of the arch or curvature, the aorta ſends out commonly three, ſometimes four large capital branches, their origins being very near each other. When there are four, the two middle branches are termed arteriæ carotides; the other two, ſubclaviæ; and both are diſtinguiſhed into right and left.

When there are but three branches, which is ofteneſt the caſe, the firſt is a ſhort trunk, common to the right ſubclavian and carotid, the ſecond is the left ſubclavian, and the third the left carotid.

The origin of the left ſubclavian terminates the aorta aſcendens.

The carotid arteries run up directly to the head, each of them being firſt divided into two, one external, the other internal. The external artery goes chiefly to the outer parts of the head and dura mater, or firſt covering of the brain. The internal enters the cranium, through the bony canal of the os petroſum; and is diſtributed through the brain by a great number of ramifications.

The ſubclavian arteries ſeparate laterally, and almoſt tranſverſely, each toward that ſide on which it lies, behind and under the claviculæ, from whence they have their name.

The ſubclavian on each ſide terminates at the upper edge of the firſt rib, between the lower inſertions of the firſt ſcalenus muſcle; and there, as it goes out of the thorax, takes the name of arteria axillaris.

During this courſe of the ſubclavian artery, ſeveral arteries ariſe from it, *viz.* the mammaria interna, mediaſtina, pericardia, diaphragmatica minor ſive ſuperior, thymica and trachealis.

The thymica and trachealis on each ſide are, in ſome ſubjects, only branches of one ſmall trunk which ſpring from the common trunk of the right ſubclavian and carotid.

They are generally ſmall arteries which run ſometimes ſeparate, and ſometimes partly ſeparate and partly joined.

The ſubclavian ſends off likewiſe the mammaria interna, vertebrales, cervicales, and ſometimes ſeveral of the upper intercoſtales.

The axillary artery, which is only a continuation of the ſubclavian from where it goes out of the thorax to the axilla, detaches chiefly the mammaria externa, or thoracica ſuperior, thoracica inferior, ſcapulares externæ, ſcapularis interna, humeralis or muſcularis, *&c.* Afterwards it is continued by different ramifications, and under different names, over the whole arm, all the way to the ends of the fingers.

The ſuperior portion of the aorta deſcendens gives off the arteriæ bronchiales, which ariſe ſometimes by a ſmall common trunk, ſometimes ſeparate, and ſometimes do not come immediately from the aorta. It next ſends off the œſophagææ, which may be looked upon as mediaſtinæ poſteriores;

posteriores; and then the intercostales from its posterior part, which in some subjects come all from this portion of the aorta, in others only the lowest eight or nine.

The inferior portion of the descending aorta, as it passes through the diaphragm, gives off the diaphragmaticæ inferiores, or phrenicæ; afterwards it sends off several branches, anteriorly, posteriorly, and laterally.

The anterior branches are the cæliaca, which supplies the stomach, liver, spleen, pancreas, *&c.* the mesenterica superior, which goes chiefly to the mesentery, to the small intestines, and that part of the great intestines which lies on the right side of the abdomen; the mesenterica inferior, which goes to the great intestines on the left side, and produces the hæmorrhoidalis interna; and lastly, the right and left arteriæ spermaticæ.

The posterior branches are the arteriæ lumbares, of which there are several pairs, and the sacræ, which do not always come from the trunk of the aorta.

The lateral branches are the capsulares and adiposæ, the origin of which often varies; the renales, formerly termed emulgents; and the iliacæ, which terminate the aorta by the bifurcation already mentioned.

The iliac artery on each side is commonly divided into the external or anterior, and internal or posterior.

The internal iliaca is likewise named arteria hypogastrica; and its ramifications are distributed to the viscera contained in the pelvis, and to the neighbouring parts, both internal and external.

The iliaca externa, which is the true continuation of the iliac trunk, goes on to the inguen, and then out of the abdomen, under the ligamentum Fallopii; having first detached the epigastrica, which goes to the musculi abdominis recti. Having quitted the abdomen, it commences arteria cruralis, which runs down upon the thigh, and is distributed by many branches and ramifications to all the lower extremity.

We shall now go on to examine particularly all the capital or original branches of the aorta, from their origin, to the entry of them and of their ramifications into all parts of the body.

The CARDIAC or coronary arteries of the heart arise from the aorta immediately on its leaving the heart. They are two in number, and go out near the two sides of the pulmonary artery, which having first surrounded, they afterwards run upon the basis of the heart in form of a kind of crown, or garland, from whence they are called coronariæ; and then pursue the superficial traces of the union of the two ventricles, from the basis of the heart to the apex, and are afterwards lost in the substance of the heart.

The CAROTID arteries are two in number, one called the right carotid, the other the left. They arise near each other, from the curvature of the aorta, the left immediately, the right most commonly from the trunk of the subclavia on the same side.

They run upon each side of the trachea arteria, between it and the internal jugular vein, as high as the larynx, without any ramification. Each of these trunks is afterwards ramified in the following manner.

The trunk having reached as high as the larynx, is divided into two large branches or particular carotids, one named *external*, the other *internal*, because the first goes chiefly to the external parts of the head, the second enters the cranium, and is distributed to the brain.

The external carotid is anterior, the internal posterior; and the external is even situated more inward, and nearer the larynx, than the other.

The external carotid is the smallest. It runs insensibly outward, between the external angle of the lower jaw, and the parotid gland, which it supplies as it passes. Afterwards it ascends on the fore-side of the ear, and ends in the temples.

In this course it sends off several branches, which may well enough be divided into anterior or internal, and posterior or external; and the principal branches of each kind are these:

The first anterior or internal branch goes out from the very origin of the carotid on the inside; and having presently afterward taken a little turn, and sent off branches to the jugular glands near it, to the fat and skin, it runs transversely, and is distributed to the glandulæ thyroidææ, and to the muscles and other parts of the larynx: It likewise sends some branches to the pharynx and muscles of the os hyoides.

The second anterior branch passes over the nearest cornu of the os hyoides, to the muscles of that bone and the tongue, and to the glandulæ sublinguales; afterwards passing before the cornu of the os hyoides, it loses itself in the tongue, from whence it has been called *arteria sublingualis*.

The third branch, or arteria maxillaris inferior, goes to the maxillary gland, to the styloid and mastoid muscles, to the parotid and sublingual glands, to the muscles of the pharynx, and to the small flexors of the head.

The fourth branch, arteria maxillaris externa, passes anteriorly on the masseter muscle, and middle of the lower jaw, near the chin. Afterwards it runs under the musculus triangularis labiorum, which it supplies as well as the buccinator and the quadratus menti.

It sends of a particular branch, very much contorted, which divides at the angular commissure of the lips, and running in the same manner along the superior and inferior portions of the musculus orbicularis, it communicates on both sides with its fellow, and thereby forms a kind of arteria coronaria labiorum.

Afterwards it ascends towards the nares, and is distributed to the muscles, cartilages, and other parts of the nose, sending down some twigs which communicate with the coronary artery of the lips. Lastly, it reaches the great angle of the eye, and is ramified and lost on the musculus orbicularis palpebrarum, superciliaris, and frontalis. Through all this course, it is named arteria angularis.

The fifth branch, maxillaris interna, arises over-against the condyle of the lower jaw. It passes behind the condyle, and having given off a twig among the musculi pterygoidæi, it is divided into three principal branches.

The first branch, or spheno-maxillaris, goes through the inferior orbitary, or sphenomaxillary fissure, to the orbit, after having supplied the musculi peristaphylini, and

and the glandulous membrane of the posterior nares, through the foramen spheno-palatinum.

It is distributed inferiorly and laterally to the parts contained in the orbit, and detaches a small subaltern branch through the extremity of the superior orbitary, or sphenoidal fissure, which enters the cranium, and is spent upon the dura mater.

It sends off likewise another subaltern branch, which passes through the posterior opening of the orbitary canal, and having furnished the maxillary sinus and the teeth, goes out by the inferior orbitary hole, and on the cheek communicates with the angular artery.

The second branch runs through the canal of the lower jaw, and being distributed to the alveoli and teeth, goes out at the hole near the chin, and loses itself in the neighbouring muscles.

The third branch runs up between the internal and external carotids, passes through the foramen spinale of the sphenoidal bone, and is distributed to the dura mater by several ramifications.

The sixth anterior or internal branch, which is very small, is spent on the musculus masseter.

The first external or posterior branch is named arteria occipitalis. It passes obliquely before the internal jugular vein, and having twigs to the musculus stylo-hyoidæus, stylo-glossus, and digastricus, it runs between the styloid and mastoid apophyses, along the mastoid groove, and goes to the muscles and integuments which cover the os occipitis, turning several times in an undulating manner, as it ascends backwards.

The second external branch spreads itself on the outward ear, by a great many small twigs on each side, several of which run inward, and furnish the cartilages, meatus auditorius, skin of the tympanum, and internal ear.

The trunk of the external carotid ascends afterward above the zygoma, passing between the angle of the lower jaw and parotid gland, and forms the temporal artery, which divides into an anterior, middle, and posterior branch.

The anterior branch of the temporal artery goes to the musculus frontalis, communicates with the arteria angularis, and sometimes gives off a very small artery, which pierces the internal apophysis of the os malæ all the way to the orbit. The middle branch goes partly to the musculus frontalis, partly to the occipitalis. The posterior branch goes to the occiput, and communicates with the arteria occipitalis. All these branches likewise furnish the integuments.

The internal carotid artery, leaving the general trunk, is at first a little incurvated, appearing as if either it were the only branch of that trunk, or a branch of the trunk of the external carotid.

It is situated a little more backward than the carotis externa, and generally runs up, without any ramification, as high as the lower orifice of the great canal of the apophysis petrosa of the os temporis. It enters this orifice directly from below upward.

At the end of this canal it is again incurvated from below upward, and enters the cranium through a notch of the sphenoidal bone. Then it bends from behind forward, and makes a third angle on the side of the sella sphenoidalis; and again a fourth, under the clinoid apophysis of that sella.

As it leaves the bony canal to enter the cranium, it sends off a branch through the sphenoidal fissure to the orbit and eye, and soon afterwards another through the foramen opticum.

Afterwards the internal carotid runs under the basis of the brain, to the side of the infundibulum, where it is at a small distance from the internal carotid of the other side, and there it commonly divides into two principal branches, one anterior, and one posterior.

The anterior branch runs forward under the brain, first separating from that on the other side, then coming nearer again, it unites with it by an anastomosis, or communication, in the interstice between the olfactory nerves. Afterwards having sent off some small arteries, which accompany these nerves, it leaves its fellow, and divides into two or three.

The first of these branches goes to the anterior lobe of the brain; the second, which is sometimes double, is inverted on the corpus callosum, to which it gives some ramifications, as also to the falx of the dura mater, and middle lobe of the brain. The third goes to the posterior lobe of the brain.

The posterior branch communicates first of all with the vertebral artery of the same side, and then divides into several rami, which run between the superficial circumvolutions of the brain, and are ramified in many different directions on and between these circumvolutions, all the way to the bottom of the sulci.

All these ramifications are covered by the pia mater, in the duplicature of which they are distributed, and form capillary reticular textures in great numbers; and afterwards are lost in the inner substance of the brain.

The Subclavian arteries are two in number, one right, the other left; and they arise from the arch of the aorta, on each side of the left carotid, which commonly lies in the middle between them; but when both carotids go out separately, they both lie between the subclaviæ.

The right subclavian is larger at the beginning than the left, when it produces the right carotid; its origin is likewise more anterior and higher, because of the obliquity of the arch of the aorta. Both of them are distributed much in the same manner, and therefore the description of one may likewise be applied to the other.

The right subclavian, the longest of the two, gives off, first of all, small arteries to the mediastinum, thymus, pericardium, aspera arteria, *&c.* which are named *mediastinum, thymicæ, pericardiæ*, and *tracheales*.

Afterward this right subclavian, at about a finger's breadth from its origin, often produces the common carotid of the same side; and at a small finger's breadth from the carotid, it gives off commonly three considerable branches, *viz.* the mammaria interna, cervicalis, and vertebralis, and sometimes an intercostal artery, which goes to the first ribs, called *intercostalis superior*.

The arteria thymica communicates with the mammaria interna, and sometimes arises from the anterior middle part of the common trunk of the subclavian and carotid.

The

The thymus receives likewife fome rami from the mammaria interna, and intercoftalis fuperior.

The pericardia arifes much in the fame manner with the thymica, and runs down upon the pericardium, all the way to the diaphragm, to which it fends fome fmall ramifications.

The mediaftina arifes fometimes immediately after the thymica, and is diftributed principally to the mediaftinum.

The trachealis, which may likewife be named *gutturalis inferior*, runs up from the fubclavia, in a winding courfe, along the afpera arteria, to the glandulæ thyroidææ and larynx, detaching fmall arteries to both fides, one of which runs to the upper part of the fcapula.

The internal mammary artery comes from the anterior and lower fide of the fubclavia, near the middle of the clavicula, and runs down, for about a finger's breadth, behind the cartilages of the true ribs, an inch diftant from the fternum.

In its paffage, it fends rami to the thymus, mediaftinum, pericardium, pleura, and intercoftal mufcles. It likewife detaches other branches through thefe mufcles, and between the cartilages of the ribs, to the pectoralis major, and other neighbouring mufcular portions; to the mammæ, membrana adipofa, and fkin.

Afterwards it goes out at the thorax, on one fide of the appendix enfiformis, and is loft in the mufculus abdominis rectus, a little below its upper part.

The cervical artery arifes from the upper fide of the fubclavian, and is prefently afterward divided into two, which come out, fometimes feparately, fometimes by a fmall common trunk. The largeft of thefe two arteries is anterior, the other pofterior.

The anterior cervicalis, running behind the carotid of the fame fide, is diftributed to the mufculus coraco-hyoidæus, maftoidæus, cutaneus, fterno-hyoidæus, and fterno-thyroidæus; to the jugular glands, the afpera arteria, the mufcles of the pharynx, bronchia, œfophagus; and to the anterior mufcles which move the neck and head.

The pofterior cervicalis arifes fometimes a little after the vertebralis, and fometimes from that artery. It paffes under the tranfverfe apophyfis of the laft vertebra of the neck, and fometimes through a particular hole in that apophyfis; and from thence runs up backward in a winding courfe, on the vertebral mufcles of the neck, and then returns in the fame manner.

The vertebral artery goes out from the pofterior and upper fide of the fubclavian, almoft oppofite to the mammaria interna and cervicalis. It runs up through all the holes in the tranfverfe apophyfes of the vertebræ of the neck, and, in its paffage, fends off little twigs, through the lateral notches of thefe vertebræ, to the medulla fpinalis and its coverings. It alfo gives arteries to the vertebral mufcles, and to other mufcles near them.

It fends off a fmall branch, which is ramified on the outer and pofterior parts of the occiput, and communicates with the cervical and occipital arteries. Having afterwards reached the great foramen of the os occipitis, it enters the cranium, and pierces the dura mater.

As foon as it enters the cranium, it fends feveral fmall ramifications to the back-part of the medulla oblongata, and to the corpora olivaria and pyramidalia, which are likewife fpread on the back fides of the fourth ventricle of the brain, and form the plexus choroides of the cerebellum.

Afterwards it advances on the apophyfis bafilaris of the os occipitis, inclining, by fmall degrees, toward the vertebral artery of the other fide, all the way to the extremity of that apophyfis, where they both join in one common trunk.

The arteria bafilaris runs forward under the great tranfverfe protuberance of the medulla oblongata, to which it gives ramifications, as well as to the neighbouring parts of the medulla.

The fpinal arteries are two in number, one anterior, and one pofterior; both produced by both vertebrales, each of which, as foon as it enters the cranium, fends out a fmall branch, by the union of which the pofterior fpinalis is formed. Afterwards the vertebrales advancing on the apophyfis bafilaris, or production of the occipital bone, detach backward two other fmall branches, which likewife meet, and, by their union, form the fpinalis anterior. Thefe fpinal arteries run down on the fore and back fides of the medulla fpinalis, and, by fmall tranfverfe ramifications, communicate with thofe which the intercoftal and lumbar arteries fend to the fame part.

The internal auditory artery goes off from each fide of the arteria bafilaris, to the organ of hearing, accompanying the auditory nerve, having firft furnifhed feveral fmall twigs to the membrana arachnoides.

The pofterior meningæa arifes from the fame trunk with the auditoria interna, and goes to the back-part of the dura mater, on the occipital and temporal bones, and fupplies the neighbouring lobes of the brain.

When the fuperior intercoftal artery does not go out from the trunk of the aorta defcendens, it commonly arifes from the lower fide of the fubclavian, and runs down on the infide of the two, three, or four uppermoft true ribs, near their heads, and fends off, under each rib, a branch, which runs along the lower edge, and fupplies the intercoftal mufcles and neighbouring parts of the pleura.

Thefe branches, or particular intercoftal arteries, communicate with each other at different diftances by fmall rami, which run upward and downward from one to the other, on the intercoftal mufcles.

The ductus arteriofus, which is found only in the fœtus and in very young children, arifes from the aorta defcendens, immediately below the left fubclavian artery. In adults, this duct is fhrunk up and clofed, and appears only like a fhort ligament adhering by one end to the aorta, and by the other to the pulmonary artery, fo that in reality it deferves no other name than that of *ligamentum arteriofum*.

The bronchial arteries go fometimes from the fore-fide of the fuperior defcending aorta, fometimes from the firft intercoftal, and fometimes from the arteria œfophagæa. Sometimes they arife feparately from each fide, to go to each lung, and fometimes by a fmall common trunk, which afterwards feparates towards the right and left hand, at the bifurcation of the afpera arteria, and accompany the ramifications of the bronchia.

The bronchialis gives a ſmall branch to the neighbouring auricle of the heart, which communicates with the arteria coronaria.

The œſophagææ are generally two or three in number, ſometimes but one. They ariſe anteriorly from the aorta deſcendens, and are diſtributed to the œſophagus, *&c.*

The inferior intercoſtals are commonly ſeven or eight on each ſide, and ſometimes ten, when the ſuperior intercoſtals ariſe likewiſe from the aorta deſcendens; in which caſe theſe run obliquely upward.

They ariſe along the back-ſide of the deſcending aorta in pairs, all the way to the diaphragm, and run tranſverſely towards each ſide, on the bodies of the vertebræ. Thoſe on the right ſide paſs behind the vena azygos; and afterwards they all run to the intercoſtal muſcles, along the lower edge of the ribs, all the way to the ſternum, or near it.

They ſend branches to the pleura, to the vertebral muſcles, to thoſe muſcles which lie on the outſides of the ribs, and to the upper portions of the muſcles of the abdomen; and they communicate with the arteriæ epigaſtricæ and lumbares.

Before they take their courſe along the ribs, each of them detaches one branch between the tranſverſe apophyſes on both ſides, to the vertebral muſcles, and another which enters the great canal of the ſpina dorſi.

Afterwards each intercoſtal artery having reached the middle of the rib, or a little more, divides into two principal branches, one internal, the other external. Soon after this diviſion, the arteries that run upon the falſe ribs, ſeparate a little from them, being gradually bent downward one after another, and are ſpread upon the abdominal muſcles.

The ſubclavian artery having left the thorax immediately above the firſt rib, in the interſtice left between the portions of the ſcalenus, there receives the name of *axillaris*, becauſe it paſſes under the axilla.

In this courſe it gives off, from its inſide, a ſmall branch to the inſide of the firſt rib; and afterwards four or five principal branches, *viz.* the thoracica ſuperior, or mammaria externa, thoracica inferior, muſcularis, or ſcapularis externa, ſcapularis interna, and humeralis.

The ſuperior thoracica, or external mammary artery, runs down, in a winding courſe, on the lateral parts of the thorax, and croſſes the ribs. It gives branches to the two pectoral muſcles, to the mamma, muſculus ſubclavius, ſerratus major, latiſſimus dorſi, and to the upper portions of the coraco-brachialis and biceps.

The inferior thoracic artery runs along the inferior coſta of the ſcapula, to the muſculus ſubſcapularis, teres major and minor, infra-ſpinatus, latiſſimus dorſi, ſerratus major, and the neighbouring intercoſtal muſcles, communicating with the arteriæ ſcapulares.

The external ſcapulary artery paſſes through the notch in the ſuperior coſta of the ſcapula, to the muſculus ſupra-ſpinatus and infra-ſpinatus, teres major and minor, and to the articulation of the ſcapula with the os humeri.

The internal ſcapularis ariſes from the axillary artery near the axilla, and runs backward, to be diſtributed to the ſubſcapularis, giving branches to the ſerratus major, to the axillary glands, and to the teres major.

The humeral artery ariſes from the lower and fore-ſide of the axillaris, and runs backward between the head of the os humeri and teres major, ſurrounding the articulation, till it reaches the poſterior part of the deltoides, to which it is diſtributed.

During this courſe, it gives ſeveral branches to the ſuperior portions of the anconæi, to the capſular ligament of the joint of the ſhoulder, and to the os humeri itſelf, through ſeveral holes immediately below the great tuberoſity of the head of that bone.

Oppoſite to the origin of this humeral artery, the axillaris ſends off another ſmall branch, which runs in a contrary direction, between the head of the os humeri, and the common upper part of the biceps and coracobrachialis; and having given branches to the vagina and channel of the biceps, and to the perioſteum, afterwards joins the principal humeralis.

The axillary artery having given off theſe branches, paſſes immediately behind the tendon of the pectoralis major, where it changes its former name for that of *arteria brachialis*. It runs down on the inſide of the arm, over the muſculus coraco-brachialis and anconæus internus, and along the inner edge of the biceps, behind the vena baſilica, giving ſmall branches on both ſides to the neighbouring muſcles, to the perioſteum, and to the bone.

Between the axilla and middle of the arm, it is covered only by the ſkin and fat; but afterwards it is hid under the biceps, and runs obliquely forward as it deſcends; being at ſome diſtance from the internal condyle, but it does not reach the middle of the fold of the arm.

Between the axilla and this place, it ſends off many branches to the infra-ſpinatus, teres major and minor, ſubſcapularis, latiſſimus dorſi, ſerratus major, and other neighbouring muſcles, to the common integuments, and even to the nerves. Below the fold of the arm, it divides into two principal branches, one called *arteria cubitalis*, the other *radialis*.

From its upper and inner part, it ſends off a particular branch, which runs obliquely downward and backward over the anconæi, and then turns forward again, near the external condyle, where it communicates with a branch of the arteria radialis.

Immediately below the inſertion of the teres major, it gives off another branch, which runs from within outwards, and from behind forward, round the os humeri; and deſcends obliquely forward, between the muſculus brachiæus, and anconæus externus, to both which it is diſtributed in its paſſage. Having afterwards reached the external condyle, it unites with the branch laſt mentioned, and likewiſe communicates with a branch of the arteries of the fore-arm, ſo that there is here a triple anaſtomoſis.

About the breadth of a finger below this ſecond branch, the brachial artery ſends off a third, which runs down towards the internal condyle, and communicates with other branches of the arteries of the fore-arm, as we ſhall ſee hereafter.

About the middle of the arm, or a little lower, much about the place where the brachial artery begins to be covered by the biceps, it ſends off a branch, which is diſtributed

distributed to the periosteum, and penetrates the bone, between the musculus brachiæus and anconæus internus.

About an inch lower, it gives off another branch, which having furnished ramifications to the anconæus internus, runs over the inner condyle, and likewise communicates with branches of the arteries of the fore-arm.

Having got below the middle of the arm, the brachial artery detaches another branch, which runs behind the inner condyle, in company with a considerable nerve; and having passed over the muscles inserted in this condyle, it communicates with that branch of the cubital artery which encompasses the fold of the arm.

A little lower, it sometimes sends out another branch, which passes on the fore-side of the inner condyle, and then communicates with a branch which runs up from the cubital artery. These three communicating branches are termed *collateral arteries*.

The common trunk of the brachial artery having reached the fold of the arm, runs, together with a vein and a nerve, immediately under the aponeurosis of the biceps, and passes under the vena mediana, detaching branches on each side to the neighbouring muscles.

About a large finger's breadth beyond the fold of the arm, this artery divides into two principal branches, one inner or posterior, named *cubitalis*; the other outer or anterior, named *radialis*.

From this bifurcation, the brachial artery sends branches on each side, to the supinator longus, pronator teres, fat, and skin. It sometimes, though very rarely, happens, that this artery is divided from its origin into two large branches, which run down on the arm, and afterwards on the fore-arm, where they have the names of *cubitalis* and *radialis*.

The cubital artery sinks in between the ulna and the upper parts of the pronator teres, perforatus, ulnaris gracilis, and radialis internus; then leaving the bone, it runs down between the perforatus and ulnaris internus, all the way to the carpus and great transverse ligament, and sends out several branches.

The first is a small artery, which runs inward to the inner condyle, and then turns upward, like a kind of recurrent, to communicate by several branches with the collateral arteries of the arm, already mentioned, and particularly with the third. A little lower down, another small branch goes off, which having run upward a little way, and almost surrounded the articulation, communicates with the second collateral artery of the arm, between the olecranum and inner condyle.

Afterwards, the cubital artery having, in its course between the heads of the ulna and radius, reached the interosseous ligaments, sends off two principal branches, one internal, the other external, called the interosseous arteries of the fore-arm.

The external artery pierces the ligament about three fingers breadth below the articulation, and presently afterwards gives off a branch, which runs up, like a recurrent, toward the external condyle of the os humeri, under the ulnaris externus and anconæus minimus, to which it is distributed, as also to the supinator brevis.

Afterward, this external interosseous artery runs down on the outside of the ligament, and is distributed to the ulnaris externus, extensor digitorum communis, and to the extensores pollicis indicis and minimi digiti; communicating with some branches of the internal interosseous artery.

Having reached the lower extremity of the ulna, it unites with a branch of the internal interosseous artery, which, at this place, runs from within outward, and is distributed, together with it, on the convex side of the carpus and back of the hand; communicating with the arteria radialis, and with a branch of the cubitalis.

By these communications, this artery forms a sort of irregular arch, from whence branches are detached to the external interosseous muscles, and to the external lateral parts of the fingers.

The internal interosseous artery runs down very close to the ligament, till it reaches below the pronator teres, between which and the pronator quadratus, it perforates the ligament, and goes to the convex side of the carpus and back of the hand, where it communicates with the external interosseous artery, with the radialis and internal branches of the cubitalis.

From the origin of the two interosseæ, the cubital artery runs down between the perforatus, perforans, and ulnaris internus, along the ulna, sending branches to the neighbouring parts.

Afterward, it passes over the internal transverse ligament of the carpus, by the side of the os pisiforme, and having furnished the skin, palmaris brevis, and metacarpius, it slips under the aponeurosis palmaris, giving off one branch to the hypothenar minimi digiti, and another, which runs toward the thumb, between the tendons of the flexors of the fingers, and the bases of the metacarpal bones.

It likewise sends off a branch, which, running between the third and fourth bones of the metacarpus, reaches to the back of the hand, where it communicates with the external interosseous artery. Afterwards, having supplied the interosseous muscles, it communicates with the radialis; and they both form an arterial arch, in the hollow of the hand.

This arch sends from its concave side, towards the second phalanx of the thumb, a branch for the lateral internal part thereof, and then ends near the head of the first metacarpal bone, by a communication with the radialis, having first given a branch to the foreside of the index, and another to the side of the thumb next the former. These communicate, at the ends of the fingers, with the neighbouring branches, as in the other fingers.

This arch sends likewise small twigs to the interosseous muscles, to the lumbricales, palmaris, and to other neighbouring parts; and, lastly, to the integuments.

The radial artery begins by detaching a small branch, which runs upward like a recurrent toward the fold of the arm, and turns backward round the external condyle, communicating with the neighbouring branches from the trunk of the brachial artery.

It runs down along the inside of the radius, between the supinator longus, pronator teres, and the integuments, giving branches to these muscles, and likewise to the perforatus, perforans, and supinator brevis. From thence it runs, in a winding course, towards the extremity of

the radius, ſupplying the flexors of the thumb and pronator quadratus.

Having reached the extremity of the radius, it runs nearer the ſkin, eſpecially toward the anterior edge of the bone, being the artery which we feel there when we examine the pulſe.

At the end of the radius, it gives off a branch to the thenar; and, after having communicated with the arch of the cubital artery in the palm of the hand, and ſet off ſome cutaneous branches at that place, it detaches one along the whole internal lateral part of the thumb.

Afterwards it runs between the firſt phalanx and tendons of the thumb, to the interſtice between the baſis of this firſt phalanx, and of the firſt metacarpal bone, where it turns to the hollow of the hand.

At this turning, it ſends off a branch to the external lateral part of the thumb, which having reached the end thereof, communicates, by a ſmall arch, with the branch which goes to the internal lateral part.

It likewiſe ſends branches outward, which run between the two firſt bones of the metacarpus, and the two tendons of the radialis externus; and it communicates with an oppoſite branch of the cubitalis, together with which it furniſhes the external interoſſeous muſcles and integuments of the back of the hand and convex ſide of the carpus.

Laſtly, the radial artery terminates, in its paſſage over the ſemi-interoſſeous muſcle of the index, near the baſis of the firſt metacarpal bone, and as it runs under the tendons of the flexor muſcles of the fingers, where it is joined to the arch of the cubitalis.

It ſends off another branch, which runs along the fore-part of the firſt bone of the metacarpus, to the convex ſide of the index, where it is loſt in the integuments.

The left Diaphragmatic artery goes out commonly from the aorta deſcendens, as it paſſes between the crura of the ſmall muſcle of the diaphragm. The right diaphragmatic comes ſometimes from the neareſt lumbar artery, but moſt commonly from the cæliaca. Theſe arteries likewiſe have the name of *arteriæ phrenicæ*.

They appear almoſt always in ſeveral ramifications on the concave or lower ſide of the diaphragm, and ſeldom on the upper or convex ſide. They give ſmall branches to the glandulæ renales, or capſulæ atrabilaria.

They ſend likewiſe ſmall branches to the fat which lies upon the kidneys, from whence they have the name of arteriæ adipoſæ.

Beſides theſe capital diaphragmatic arteries, there are others of a ſubordinate claſs, which come from the intercoſtales, mammariæ internæ, mediaſtinæ, pericardiæ, and cæliaca.

The cæliac artery ariſes anteriorly, and a little to the left hand, from the aorta deſcendens, immediately after its paſſage through the ſmall muſcle of the diaphragm, nearly oppoſite to the cartale, between the laſt vertebra of the back, and the firſt of the loins. The trunk of this artery is very ſhort; and near its origin, it ſends off from the right ſide two ſmall diaphragmaticæ, though ſometimes there is only one, which goes to the right hand, and is afterwards diſtributed both ways; communicating with the other arteries of the ſame name, which come from the intercoſtales and mammariæ. The left branch ſends rami to the ſuperior orifice of the ſtomach, and to the glandula renalis on the ſame ſide; the right furniſhes the pylorus, and the renal gland on the right ſide.

Immediately after this, the cæliaca gives off a conſiderable branch, named *arteria ventriculi coronaria*, and *gaſtrica*, or *gaſtrica ſuperior*; and then it preſently divides into two large branches, one toward the right hand, named *arteria hepatica*; the other to the left, called *ſplenica*.

The coronary artery of the ſtomach goes firſt to the left ſide of that organ, a little beyond the ſuperior orifice; round which orifice it throws branches, and alſo to every part of the ſtomach near it; and theſe branches communicate with thoſe which run along the bottom of the ſtomach to the pylorus.

Afterwards it runs on the right ſide of the ſuperior orifice, along the ſmall curvature of the ſtomach, almoſt to the pylorus, where it communicates with the arteria pylorica; and turning towards the ſmall lobe of the liver, it gives off ſome branches to it.

Then it advances, under the ductus venoſus, to the left lobe of the liver, in which it loſes itſelf near the beginning of the duct, having firſt given off ſome ſmall branches to the neighbouring parts of the diaphragm and omentum.

As ſoon as the hepatic artery leaves the cæliaca, it runs to the upper and inward part of the pylorus, in company with the vena portæ, ſending off two branches, a ſmall one called *arteria pylorica*, and a large one named *gaſtrica dextra*, or *gaſtrica major*.

The pylorica is ramified on the pylorus, and having diſtributed branches to the neighbouring parts of the ſtomach, which communicate with thoſe of the right gaſtrica, it terminates on the pylorus, by an anaſtomoſis with the coronary artery of the ſtomach.

The right gaſtric artery having paſſed behind and beyond the pylorus, ſends out a conſiderable branch, named *arteria duodenalis*, or *inteſtinalis*, which ſometimes comes from the trunk of the hepatica, as we ſhall ſee hereafter. Afterwards this gaſtric artery runs along on the right ſide of the great curvature of the ſtomach, to the neighbouring parts of which, on both ſides, it diſtributes branches.

Theſe branches communicate with thoſe of the arteria pylorica, and of the coronaria ventriculi, and with the right gaſtro-epiploicæ, which furniſh the neareſt part of the omentum, and communicate with the meſenterica ſuperior. After this, the right gaſtric artery ends in the left, which is a branch of the ſplenica.

The duodenal or inteſtinal artery runs along the duodenum on the ſide next the pancreas; to both which it furniſhes branches, and alſo to the neighbouring part of the ſtomach.

The hepatic artery, having ſent out the pylorica and right gaſtrica, advances behind the ductus hepaticus, toward the veſicula fellis, to which it gives two principal branches

branches called *arteriæ cyſticæ;* and another named *bilaria*, which is loſt in the great lobe of the liver.

Afterwards, this artery enters the fiſſure of the liver, and joins the vena portæ, with which it runs within a membranous vagina, called *capſula Gliſſoni*, and accompanies it through the whole ſubſtance of the liver by numerous ramifications, which may be termed *arteriæ hepaticæ propriæ*.

Before it enters the liver, it gives ſmall branches to the external membrane of this viſcus, and to the capſula Gliſſoni.

Immediately after the origin of the ſplenic artery from the cæliaca, it runs toward the left hand, under the ſtomach and pancreas, to the ſpleen. It adheres cloſely to the poſterior part of the lower ſide of the pancreas, to which it gives ſeveral branches, named *arteriæ pancreaticæ*.

Near the extremity of the pancreas, under the left portion of the ſtomach, the ſplenic artery gives off a principal branch, called *gaſtrica ſiniſtra* or *minor*, which runs from left to right along the left portion of the great curvature of the ſtomach, giving branches to both ſides of this portion, which communicate with thoſe of the coronaria ventriculi.

This gaſtric artery ſends likewiſe another branch at leaſt to the extremity of the pancreas, which communicates with the other pancreatic arteries. It alſo ſupplies the omentum with branches, termed *gaſtro-epiploicæ ſiniſtræ*; and then it communicates with the right gaſtrica; and from this union, the gaſtro-epiploicæ mediæ are produced.

Afterwards, the ſplenic artery advances towards the ſpleen, in a courſe more or leſs contorted; but before it arrives at that viſcus, it gives two or three branches to the large extremity of the ſtomach, commonly called *vaſa brevia*; and one to the omentum, named *epiploica*.

At the ſpleen, this artery divides into four or five branches, which enter that viſcus, after having given ſome ſmall twigs to the neighbouring parts of the ſtomach and omentum.

The ſuperior meſenteric artery ariſes anteriorly from the lower portion of the deſcending aorta, a very little way below the cæliaca, going out a little towards the right hand, but bending immediately afterwards to the left.

Near its origin, it gives off a ſmall branch, which dividing into two, goes to the lower ſide of the head of the pancreas, and neighbouring part of the duodenum, communicating with the inteſtinalis by ſmall arches, and areolæ or maſhes.

Afterwards it paſſes over the duodenum, between this inteſtine and the meſeraic vein, between the two laminæ of the meſentery; and then bending in an oblique direction from left to right, and from above downward, by very ſmall degrees, it advances toward the extremity of the ileum. By this incurvation, it forms a kind of long arch, from the convex ſide of which a great many branches go out.

Theſe branches are ſixteen or eighteen in number, or thereabouts, and almoſt all of them are beſtowed on the ſmall inteſtines, from the lower third part of the duodenum to the cæcum and colon.

As they approach the inteſtines, all theſe branches communicate, firſt by reciprocal arches; then by ariolæ and maſhes of all kinds of figures; from which is detached an infinite number of ſmall ramifications, which ſurround the inteſtinal canal, like an annular piece of network.

The firſt branches from the convex ſide of the meſenteric arch, which are very ſhort, ſupply the pancreas and meſocolon, and communicate with the duodenal artery. The laſt branches go to the appendicula vermiformis, and ſend a portion of an arch to the beginning of the colon.

The conſiderable branches from the concave ſide of the meſenteric arch, are ſeldom above two or three in number; but before they ariſe, a ſmall ramus goes out to the duodenum, and gives ſome very ſmall arteries to the pancreas.

The firſt conſiderable branch from the concave ſide of the arch goes into the meſocolon towards the right portion of the colon.

The ſecond principal branch, having run for ſome ſpace through the meſentery, divides into three rami; the firſt of which goes to the lower part of the right portion of the colon, the ſecond goes to the beginning of the colon and inteſtinum cæcum.

The third ramus of the ſecond branch, having communicated with the ſecond, gives ſmall twigs to the cæcum, appendicula vermiformis, and extremity of the ileum.

The lower meſenteric artery goes out anteriorly from the aorta deſcendens inferior, about a finger's breadth or more above the bifurcation, and below the ſpermatic arteries; and having run about the length of an inch, or ſomething more, it is divided into three or four branches.

The firſt or ſuperior branch, about an inch from its origin, divides into two rami; the firſt of which runs along the left portion of the colon. The ſecond ramus having communicated with the firſt, runs down upon the ſame portion of the colon.

The middle branch divides into two rami; one of which paſſes upward on the extremity of the colon, communicating by arches with the ſecond ramus of the ſuperior branch; the other runs down on the extremity of the ſame inteſtine.

The lower branch goes to the ſecond portion of the colon, or to both.

It ſends another conſiderable branch downward, called *arteria hæmorrhoidalis interna*, which runs down behind the inteſtinum rectum, to which it is diſtributed by ſeveral ramifications.

The renal arteries, commonly called *emulgents*, are ordinarily two in number, and go out laterally from the inferior deſcending aorta, immediately under the meſenterica ſuperior, one to the right hand, the other to the left.

They run commonly without diviſion, and almoſt horizontally to the kidneys, into the depreſſions of which they enter by ſeveral branches, which form arches in the inner ſubſtance of theſe viſcera.

From theſe arches, numerous ſmall rami go out to-

ward the circumference or outer surface of the kidneys.

Ordinarily, the right renal artery passes behind the vena cava and renal vein on the other side; and the left artery, first behind and then before the vein.

The arteries of the renal glands, which may be termed *arteriæ capsulares*, arise sometimes from the aorta above the arteria renalis, and give out the arteriæ adiposæ, which go to the fat of the kidneys. Sometimes they come from the trunk of the cæliaca. The right capsular artery comes most commonly from the arteria renalis of the same side, near its origin; the left from the aorta, above the renalis.

The spermatic arteries are commonly two in number, sometimes more. They are very small, and go out anteriorly from the aorta descendens inferior, near each other, about a finger's breadth below the arteriæ renales, between the two mesentericæ, or between the renales and mesentericæ inferiores.

They send off to the common membrane of the kidney small branches, named *arteriæ adiposæ*; and afterwards they run down upon the psoas muscles, on the fore-side of the ureters, between the two laminæ of the peritonæum.

They give several considerable branches to the peritonæum, and communicate both with the mesentericæ and adiposæ. They likewise send small arteries to the ureters.

Afterwards, they pass in men through the tendinous openings of the abdominal muscles in the vagina of the peritonæum, and are distributed to the testicles and epididymis, where they communicate with a branch of the iliaca externa.

In women they do not go out of the abdomen, but are distributed to the ovaria and uterus, and communicate with branches of the hypogastrica, at the jagged extremities of the tubæ Fallopianæ.

The lumbar arteries go out posteriorly from the inferior descending aorta, in five or six pairs, or more, much in the same manner with the intercostals.

They may be divided into superior and inferior. The superior send small branches to the neighbouring parts of the diaphragm and intercostal muscles, and supply the place of semi-intercostal arteries.

They are distributed on each side to the psoas muscles, to the quadrati lumborum, and to the oblique and transverse muscles of the abdomen; and by perforating the oblique muscles, they become external hypogastric arteries. They go likewise to the vertebral muscles, and to the bodies of the vertebræ, and enter the spinal canal through the lateral notches, to go to the membranes, *&c.* forming rings much in the same manner with the intercostals.

The arteriæ sacræ go out commonly from the back part of the inferior descending aorta, at the bifurcation. They are two, three, or four in number, and sometimes but one. They are ramified on the os sacrum, and on the neighbouring parts of the peritonæum, intestinum rectum, fat, *&c.* and enter the canal of that bone through the anterior holes, being there distributed toward each side. They likewise send small arteries to the large fasciculi of nerves, which go out through the holes of the os sacrum, and they penetrate the inner substance of that bone.

The inferior descending aorta ends at the last vertebra of the loins, and sometimes higher, in two large lateral branches, one on the right hand, the other on the left, called *arteriæ iliacæ*; each of which is a common trunk to two other arteries of the same name. This bifurcation lies on the anterior and left side of that of the vena cava.

The primitive iliac arteries divaricate gradually as they descend, advancing obliquely toward the anterior and lower part of the ossa ilium, without any considerable ramification for about the breadth of three fingers, except a few very small arteries that go to the os sacrum. They likewise give small arteries to the peritonæum, to the coats of the veins, and to the fat and ureters.

The right iliac trunk passes first on the foreside of the origin of the left iliac vein, and runs down on the foreside of the right vein, almost to the place where it goes out of the abdomen, its course being there directed more inwardly. The left trunk goes down likewise before the left vein, but lies a little toward the inside as it leaves the abdomen.

About three fingers breadth from their origin, each iliac trunk is divided into two secondary arteries, one external, the other internal. The external artery has no particular name; the internal is termed *hypogastrica*.

The external iliaca on each side runs down on the iliac muscle to the ligamentum Fallopii, under which it goes out of the abdomen. In this course, it gives off only a few small arteries to the peritonæum, and other parts near it; but as it passes out of the abdomen under the ligament, it detaches two considerable branches, one internal, the other external.

The internal branch is named *arteria epigastrica*, and goes out anteriorly from the external iliaca. From thence it runs obliquely upward on the tendon of the transverse muscle towards the posterior part of the rectus.

Afterwards the epigastric artery runs up along the posterior or inner side of this muscle, sending ramifications to the tendons of the neighbouring muscles, *&c.* and then loses itself by a true anastomosis of several ramifications, with the mammaria interna.

The external branch of the outer iliaca goes off laterally from the outside of that artery under the ligamentum Fallopii, and from thence to the internal labium of the os ilium, where it divides into two, and is ramified on the oblique and transverse muscles of the abdomen communicating with the arteria lumbaris.

Besides these two branches, the external iliaca gives off a small ramus internally, under the ligament, which runs to the vagina of the spermatic rope; and sometimes another small twig goes from the outside to the os ilium.

The internal iliaca or hypogastrica, having run a little more than a finger's breadth inward and backward, bends by small degrees obliquely forward, and toward the outside; and afterwards contracting in its dimensions, it ends in the umbilical artery, which ought to be looked upon as a true continuation of the trunk of the hypogastrica.

This arteria umbilicalis ascends on the side of the bladder, and having detached small rami to that viscus and to the neighbouring parts of the peritonæum, *&c.* it contracts, and in adults is quite closed up above the middle

middle of the bladder. It likewise gives branches to the uterus, and to the neighbouring parts in both sexes. Afterwards it aſcends in form of a ligament to the umbilicus, where it joins the umbilical artery on the other ſide.

From the convex ſide of the curvature of the hypogaſtric artery, four or five principal branches commonly go out very near each other, *viz.* iliaca minor, glutæa, ſciatica, pudica communis, ſive pudica hypogaſtrica, and obturatrix.

The iliaca minor, the moſt poſterior of theſe branches, and which is often no more than a ramus of the glutæa, paſſes between the laſt two lumbar nerves, and divides into two rami, one of which enters the canal of the os ſacrum through the loweſt large anterior holes; the other paſſes behind the muſculus pſoas, to which it gives twigs, and behind the crural nerve, being afterwards diſtributed to the iliac muſcle, and to the middle part of the inſide of the os ilium, penetrating into the ſubſtance of the bone ſometimes by one hole, ſometimes by more.

The arteria glutæa is ſometimes the largeſt of all the hypogaſtric branches. Near its beginning it ſometimes ſends out the iliaca minor, and ſometimes the ſmall ramus that goes from that artery to the os ſacrum and other parts fixed to that bone. Afterwards this artery goes out of the pelvis, in company with the ſciatic nerve, through the upper part of the great ſinus of the os innominatum, below the muſculus pyriformis, and is diſtributed, in a radiated manner, to the glutæus maximus and medius.

In its paſſage, it gives ſome branches to the os ſacrum, os coccygis, muſculus pyriformis, the muſcles of the anus, and to the neighbouring parts of the inteſtinum rectum, forming a particular hæmorrhoidalis interna. It likewiſe ſends twigs to the bladder and parts near it; and detaches a pretty long branch, which runs down with the ſciatic nerve.

The arteria ſciatica gives firſt of all ſome branches to the muſculus pyriformis, the quadrigemini, the os ſacrum, *&c.* and even to the inner ſide of the os iſchium. It likewiſe detaches a branch, which runs under the muſculus quadratus, to the articulation of the os femoris.

The pudica communis, called commonly *pudica interna*, ariſes ſometimes by a trunk common to it and to the glutæa, and gives out two principal branches; the firſt of which paſſes through the great ſinus of the os ilium, in company with the glutæa and ſciatica, and then divides into two rami.

The firſt ramus goes behind the ſpine of the iſchium, between the two ligaments which lie between that bone and the os ſacrum; and runs on the inſide of the tuberculum iſchii, all the way to the origin of the corpus cavernoſum penis. There it divides into ſeveral arteries, one of which goes to the ſphincter ani, under the name of *hæmorrhoidalis externa.*

The reſt are diſtributed to the neighbouring integuments, to the bulb of the urethra, and to the corpus cavernoſum penis; but the laſt of theſe arteries, or rather the extremity of this firſt ramus, runs from behind foreward, over the neck of the os femoris, and communicates with a branch of the arteria cruralis.

The ſecond principal ramus, called commonly *arteria pudica externa*, runs between the bladder and inteſtinum rectum, and is diſtributed in men to the veſiculæ ſeminales, neck of the bladder, proſtate gland, and neighbouring parts of the rectum.

Afterwards it runs under the os pubis on the ſide of a conſiderable vein, which lies directly under the ſymphyſis; and it runs along the penis between this vein and a nerve, being diſtributed in its paſſage to the corpus cavernoſum, and communicating with the pudica minor, which comes from the cruralis.

This ſecond branch of the pudica major goes off ſometimes ſeparately from the hypogaſtrica, eſpecially in women, being diſtributed to the lateral parts of the uterus, where it communicates with the ſpermatic artery, near the jagged extremity of the tuba Fallopiana, and to the neighbouring parts of the vagina, *&c.*

The arteria obturatrix perforates the obturator muſcles, and goes out of the pelvis at the upper part of the ligament of the foramen ovale, having firſt ſent a ſmall branch over the ſymphyſis of the os ilium and os pubis, to the inguinal glands and integuments.

As it paſſes by the muſcles, it divides and is diſtributed to the pectineus and triceps. It likewiſe ſends out another branch, which communicates with that branch of the ſciatica that goes to the articulation of the os femoris; and gives ſmall arteries to the holes in the neck of that bone.

The iliac artery goes out of the abdomen, between the ligamentum Fallopii and tendon of the pſoas, at the union of the os ilium and os pubis, and there it takes the name of *arteria cruralis.*

It ſends off, firſt of all, three ſmall branches; one of which, called *pudica externa*, goes over the crural vein to the ſkin and ligament of the penis, and to the inguinal glands, communicating with the pudica interna. The ſecond goes to the muſculus pectineus; and the third to the upper part of the ſartorius. All theſe branches furniſh likewiſe the neighbouring anterior integuments.

Afterwards the crural artery runs down on the head of the os femoris; and, by taking a particular turn, gets on the inſide of the crural vein, about three fingers breadth from where it goes out of the abdomen.

In changing its ſituation, it ſends out three conſiderable branches, one external, one middle, and one internal.

The external branch runs on the upper ſide of the thigh to the crureus, vaſtus externus, rectus anterior, muſculus faſciæ latæ, and glutæus medius; ſending up a ramus to the apex of the great trochanter, which communicates with the firſt principal ramus of the pudica major and ſciatica.

The middle branch runs down on the inſide of the thigh between the triceps muſcles, to which it gives ſeveral rami, one whereof perforates the ſecond muſcle, and is diſtributed to the glutæus maximus, ſemi-nervoſus, ſemi-membranoſus, biceps, and to the neighbouring integuments.

The internal branch runs backward on the quadrigemini, towards the great trochanter; and having detached a ramus, which goes into the joint of the os femoris, it

it runs downward, and gives rami to all the muſcles that lie on the backſide of that bone, one of which enters the bone itſelf on one ſide of the linea aſpera.

Having ſent off all theſe three branches, the arteria cruralis runs down between the ſartorius, vaſtus internus, and triceps, giving branches to all the parts near it. It is covered by the ſartorius all the way to the lower part of the thigh, where it is inflected backward over the triceps tertius a little above the internal condyle of the os femoris. Afterwards, continuing its courſe through the hollow of the ham, it is called *arteria poplitea*.

The poplitea, while in the ham, is covered only by the integument, ſending off branches toward each ſide, which run up upon the condyles, and communicate with the lower ramifications of the arteria cruralis.

It ſends rami to the joint of the knee, one of which at leaſt paſſes between the crucial ligaments. As it runs down, it ſends branches to the gaſtrocnemii and popliteus; and having reached the backſide of the head of the tibia, it gives off two branches, one to each ſide.

The firſt or internal branch ſurrounds the fore-part of the head of the tibia, paſſing between the bone and internal lateral ligament; and beſides ſeveral other ramifications, ſends up a ſmall branch, which communicates with the arteries that lie round the condyles of the os femoris.

The ſecond or external branch runs over the head of the fibula, and between the head of the tibia and external lateral ligament of the knee, ſurrounding the articulation all the way to the ligament of the patella, and communicating with the branches which lie round the condyles of the os femoris, together with a branch of the firſt or internal ramus.

Immediately after the origin of theſe two rami, and before the poplitea ends, it ſends a ſmall artery down on the backſide of the interoſſeous ligament, very near the tibia, into which it enters by a particular hole a little above the middle portion of the bone.

As the poplitea ends, it divides into two principal branches, one of which runs between the heads of the tibia and fibula, paſſing from behind forwards on the interoſſeous ligament, where it takes the name of *arteria tibialis anterior*. The ſecond branch divides into two others; one internal and largeſt, called *arteria peronæa anterior*; the other poſterior and ſmalleſt, named *arteria peronæa poſterior*.

The tibialis anterior, having paſſed between the heads of the tibia and fibula, ſends ſmall branches upward and laterally. The ſuperior branches communicate with thoſe rami of the popliteus which lie round the articulation; and the lateral branches go to the neighbouring parts. Afterwards this tibial artery runs down on the foreſide of the interoſſeous ligament, toward the outſide of the tibia, between the muſculus tibialis anticus and extenſor pollicis.

Having run laterally on the tibia for about two thirds of the length of that bone, it paſſes on the foreſide under the common annular ligament, and extenſor pollicis, to the articulation of the foot; giving off ſeveral rami both to the right and left hand, which communicate laterally with the tibialis poſterior and peronæa poſterior, ſo that theſe two bones are in a manner ſurrounded by arteries.

At the joint of the foot, it ſends out branches which run between the aſtragalus and os calcis, being diſtributed to the articulation and to the bones of the tarſus.

Having paſſed the fold of the foot, it ſends off, toward both ſides, other rami, which communicate with the poſterior tibialis and peronæa; all theſe branches making a kind of circles round the tarſus.

Afterwards the anterior tibial artery advances on the convex ſide of the foot, as far as the interſtice between the firſt and ſecond metatarſal bones; between the heads of which it ſends a large branch, which perforates the ſuperior interoſſeous muſcles, and, joining the tibialis poſterior, forms an arch on the ſide of the foot.

It likewiſe ſends two or three conſiderable branches over the other metatarſal bones, which go to the reſt of the interoſſeous muſcles, integuments, *&c.* and communicate with each other.

Laſtly, This artery terminates by two principal branches, one of which goes to the thenar and inſide of the great toe; the other is ſpent upon the outſide of the great toe, and the inſide of the ſecond toe.

The tibialis poſterior, called likewiſe *ſuralis*, runs down between the ſolei, tibialis poſticus, flexor digitorum communis, and flexor pollicis; giving branches to theſe muſcles, to the tibia, and to the marrow of that bone, through a particular canal in its poſterior and upper part.

Afterwards it runs behind the inner ankle, communicating with the tibialis anterior, and ſurrounded by the neighbouring veins; and paſſes to the ſole of the foot between the concave ſide of the os calcis and thenar muſcle, where it divides into two branches, one large or external, the other ſmall or internal.

The great branch, or arteria plantaris externa, paſſes on the concave ſide of the os calcis obliquely under the ſole of the foot, to the baſis of the fifth metatarſal bone, and from thence runs in a kind of arch toward the great toe, communicating there with the tibialis anterior, which perforates the interoſſeous muſcles.

The convex ſide of this arch ſupplies both ſides of the laſt three toes, and the outſide of the ſecond toe, forming ſmall communicating arches as in the hand.

The ſmall branch, or arteria plantaris interna, having reached beyond the middle of the ſole of the foot, is divided into two; one of which goes to the great toe, communicating with the ramus of the tibialis anterior; the other is diſtributed to the firſt phalanges of the other toes, communicating with the ramifications from the arch already mentioned.

The arteria peronæa runs down on the backſide of the fibula, between the ſoleus and flexor pollicis, to which, and to the neighbouring parts, it gives rami in its paſſage.

Having reached to the lower third part of the fibula, it ſends off a conſiderable branch, which runs in between the tibia and that bone, paſſing between their extremities from behind forward, below the interoſſeous ligament, and is diſtributed to the integuments of the tarſus.

Laſtly,

Laſtly, the peronæa continuing its courſe downward, on the backſide of the fibula, as far as the os calcis, forms an arch with the tibialis poſterior, between the aſtragalus and the tendo-achillis.

From thence it runs outward, and a little above the outer ankle communicates with the tibialis anterior by an arch, which ſends ſeveral ſmall ramifications to the neighbouring parts.

PART IV.

OF THE VEINS.

THE blood, diſtributed to all parts of the body by two kinds of arteries, the aorta and arteria pulmonaris, returns by three kinds of veins, called by anatomiſts *vena cava, vena portæ*, and *vena pulmonaris*.

The vena cava carries back to the right auricle of the heart, the blood conveyed by the aorta to all parts of the body except what goes by the arteriæ coronariæ cordis. It receives all this blood from the arterial ramifications in part directly, and in part indirectly.

The vena portæ receives the blood carried to the floating viſcera of the abdomen by the arteria cæliaca and the two meſentericæ, and conveys it to the vena hepatica, and from thence to the vena cava.

The vena pulmonaris conveys to the pulmonary ſinus, or left auricle of the heart, the blood carried to the lungs by the arteria pulmonaris.

We commonly talk of the vena cava in general, as if it were but one vein at its origin, or had but one common trunk; whereas it goes out from the right auricle of the heart by two large ſeparate trunks, in a direction almoſt perpendicularly oppoſite to each other, one running upward, called *vena cava ſuperior;* the other downward, called *vena cava inferior*.

The vena cava ſuperior is diſtributed chiefly to the thorax, head, and upper extremities, and but very little to the parts below the diaphragm.

The vena cava inferior is diſtributed chiefly to the abdomen and lower extremities, and but very little to the parts above the diaphragm.

The trunk of each of theſe two veins ſends off, much in the ſame manner with the arteries, a certain number of principal or capital branches, which are afterwards ramified in different manners. Each trunk terminates afterwards by a bifurcation or a diviſion into two ſubordinate trunks, each of which gives off other principal branches, ending in a great number of ſmall trunks, rami, and ramifications.

The ſuperior vena cava runs up from the right auricle of the heart, almoſt in a direct courſe, for about two fingers breadth, lying within the pericardium, in the right ſide of the trunk of the aorta, but a little more anteriorly.

As it goes out of the pericardium, it is inclined a little to the left hand, and then runs up as high as the cartilage of the firſt true rib, and a little higher than the curvature of the aorta. At this place it terminates by a bifurcation or diviſion into two large branches or ſubordinate trunks, one of which runs toward the left hand, the other toward the right.

Theſe two branches are named *ſubclaviæ*, as lying behind the claviculæ.

The trunk of the ſuperior cava, from where it leaves the pericardium to the birfurcation, ſends out anteriorly ſeveral ſmall branches. Theſe branches are the vena mediaſtina, pericardia, diaphragmatica ſuperior, thymica, mammaria interna, and trachealis.

All theſe ſmall branches from the trunk of the cava ſuperior are termed *dextræ*; and their fellows on the other ſide, called *ſiniſtræ*, do not ariſe from the trunk, but from the left ſubclavia.

Poſteriorly, a little above the pericardium, the trunk of the ſuperior cava ſends out a capital branch, called *vena azygos*, or *vena ſine pari*, which runs down on the right ſide of the bodies of the vertebræ dorſi, almoſt to the diaphragm; giving off the greateſt part of the venæ intercoſtales and lumbares ſuperiores.

The two ſubclaviæ run laterally or toward each ſide, and terminate as they go out of the thorax, between the firſt rib and clavicula.

The right ſubclavian, which is the ſhorteſt of the two, commonly ſends out four capital branches; the jugularis externa, jugularis interna, vertebralis, and axillaris.

The left ſubclavian being longer than the right, gives off, firſt of all, the ſmall veins on the left ſide, anſwering thoſe on the right ſide that come from the trunk of the ſuperior cava, *viz.* the mediaſtina, pericardia, diaphragmatica ſuperior, thymica, mammaria interna, and trachealis.

Next to theſe ſmall veins, called *ſiniſtræ*, it detaches another ſmall branch, called *intercoſtalis ſuperior ſiniſtra*, and then four large branches like thoſe from the right ſubclavian, *viz.* the jugularis externa, jugularis interna, vertebralis, and axillaris, which are termed *ſiniſtræ*.

The external jugular veins are diſtributed chiefly to the outer parts of the throat, neck and head; and ſend a ſmall vein to the arm, named *cephalica*, which aſſiſts in forming a large one of the ſame name.

The internal jugular veins go to the internal parts of the neck and head, communicating with the ſinuſes of the

the dura mater, and in ſeveral places with the external jugular veins.

The vertebral veins paſs through the holes in the tranſverſe apophyſes of the vertebræ of the neck, ſending branches to the neck and occiput. They form the ſinus venales of theſe vertebræ, and communicate with the ſinuſes of the dura mater.

The axillary veins are continuations of the ſubclaviæ, from where theſe leave the thorax, to the axillæ. They produce the mammariæ internæ, thoracicæ, ſcapulares or humerales, and a branch to each arm, which, together with that from the external jugularis, forms the vena cephalica.

Afterwards the axillary vein terminates in the principal vein of the arm, called *baſilica;* which, together with the cephalica, is diſtributed by numerous ramifications to all parts of the arm, fore-arm, and hand.

The portion of the inferior vena cava contained in the pericardium is very ſmall, being ſcarcely the twelfth part of an inch on the fore-part, and not above a quarter of an inch on the back part. From thence it immediately perforates the diaphragm, to which it gives the venæ diaphragmaticæ inferiores or phrenicæ.

It paſſes next behind the liver, through the great ſinus of that viſcus, to which it furniſhes ſeveral branches, termed *venæ hepaticæ.*

In this courſe it inclines a little toward the ſpina dorſi and aorta inferior, the trunk and ramifications of which it afterwards accompanies in the abdomen, all the way to the os ſacrum.

Thus the inferior cava ſends out on each ſide, in the ſame manner with the aorta, the venæ adipoſæ, renales, ſpermaticæ, lumbares, and ſacræ. Having reached to the os ſacrum, it loſes the name of cava, and terminating by a bifurcation, like that of the deſcending aorta, it forms the two venæ iliacæ.

Theſe iliac veins having given off the hypogaſtricæ, with all their ramifications, to the viſcera of the pelvis, and to ſome other external and internal neighbouring parts, go out of the abdomen, under the ligamentum Falloppii, and there take the name of *venæ crurales.*

Each crural vein ſends off numerous ramifications to all the lower extremity.

The vena azygos or ſine pari is very conſiderable, and ariſes poſteriorly from the ſuperior cava a little above the pericardium.

It is immediately afterwards bent backward over the origin of the right lung, forming an arch which ſurrounds the great pulmonary veſſels on that ſide.

From thence it runs down on the right ſide of the vertebræ dorſi on one ſide of the aorta, and before the intercoſtal arteries; and getting behind the diaphragm, it terminates by a very ſenſible anaſtomoſis, ſometimes with the vena renalis, ſometimes with a neighbouring lumbar vein, and ſometimes immediately with the trunk of the cava inferior.

The vena azygos ſends out two or three ſmall veins from the top of the arch, one of which goes to the aſpera arteria; the others partly to the aſpera artera, and partly to the bronchia, by the name of venæ bronchiales, accompanying the ramifications of the bronchial artery.

Afterwards the azygos detaches from the extremity of the arch a ſmall trunk common to two or three ſmall veins, called *intercoſtales ſuperiores dextræ,* which bring back the blood from the firſt three ſeries of intercoſtal muſcles, and from the neighbouring part of the pleura.

Theſe intercoſtal veins ſend branches through the intercoſtal muſcles to the ſerratus ſuperior poſticus, ſerratus major, *&c.* and afterwards they run along the interſtices between the ribs, communicating with the venæ mammariæ.

They likewiſe ſend ſmall branches backward to the vertebral muſcles and canal of the ſpine, where they communicate with the venal circles, or ſinuſes which bring back the blood from the medulla ſpinalis.

As the azygos runs down, it ſends off the inferior intercoſtal veins on the right ſide, one going to each ſeries of intercoſtal muſcles. Theſe veins run along the lower edges of the ribs, and perforate the muſcles by branches, which go to the poſterior and external part of the thorax.

They communicate with the venæ thoracicæ, and moſt commonly with the mammaria interna; and laſtly, more or leſs with each other, by perpendicular branches, near the poſterior extremities of the ribs.

The azygos ſends off likewiſe the left intercoſtal veins, but ſeldom the whole number; for the ſuperior veins come often from the left ſubclavian. The inferior intercoſtal veins, to the number of ſix or ſeven, come often from the trunk of the azygos; and running between the aorta and vertebræ, they ſend off almoſt the ſame ramifications with the veins on the right ſide, and likewiſe ſome to the œſophagus.

The azygos, having reached below the laſt rib, ſends off a large branch, which bending outward, perforates the muſcles of the abdomen, is ramified between their different planes, and communicates with the like ramifications of the laſt or laſt two intercoſtal veins.

The pectorales internæ, are ſmall veins diſpoſed in pairs toward the right and left hand, behind the ſternum and parts near it, including the diaphragmaticæ ſuperiores, or pericardio-diaphragmaticæ, mediaſtinæ, mammariæ internæ, thymicæ, pericardiæ, and gutturales or tracheales.

The right vena mediaſtina goes out anteriorly from the trunk of the ſuperior cava, a little above the origin of the azygos; the left comes from the ſubclavia.

The right ſuperior diaphragmatica, or pericardio-diaphragmatica, comes anteriorly from the root of the bifurcation near the mediaſtina; and is diſtributed, by ſeveral branches, to the upper, fore, and back parts of the pericardium, communicating with thoſe of the left diaphragmatica. The left ſuperior diaphragmatica comes from the left ſubclavian, a little below the origin of the mammaria.

The right internal mammaria ariſes anteriorly from the vena cava, a little below the angle of the birfurcation. It runs along the neareſt internal or poſterior edge of the ſternum, and on the cartilaginous extremities of the

the right ribs, together with the artery of the ſame name. Having reached near the diaphragm, it ſends it a branch which runs toward the tendinous plane, and communicates with the common diaphragmatic veins.

Afterwards this mammary vein gives ſmall branches to the mediaſtinum, and others between the ribs to the integuments; of which thoſe that paſs between and under the cartilages of the laſt true ribs, run down on the inner or poſterior ſide of the muſculi recti abdominis, being ramified among their fleſhy fibres, and communicating with the epigaſtric veins by ſeveral ſmall twigs.

The left internal mammaria ariſes anteriorly from the left ſubclavian, oppoſite to the cartilage or anterior extremity of the firſt true rib.

The right vena thymica, when it ariſes ſeparately, goes out from the bifurcation; and when it is wanting, the thymus, from whence it takes its name, is furniſhed by the gutturalis, or ſome other neighbouring vein. This vein often reaches no lower than the inferior part of the thymus; and the left vein of the ſame name comes from the left ſubclavian, almoſt oppoſite to the ſternum.

The right pericardia ſeems to go out rather from the origin of the right ſubclavian, than from the trunk of the ſuperior cava. It goes to the upper ſide of the pericardium, and other neighbouring parts.

The right gutturalis or trachealis goes out from the upper part of the bifurcation, above the mammaria of the ſame ſide, ſometimes more backward, and ſometimes from the ſubclavia. It is diſtributed to the glandulæ thyroidææ, trachea arteria, muſculi ſterno-hyoidæi, thymus, and glandulæ bronchiales. It communicates, by lateral branches, with the internal jugular vein. The left gutturalis comes from the upper or poſterior part of the left ſubclavian, near its orign.

The right ſubclavian vein is very ſhort, and its courſe very oblique, ſo that it appears to riſe higher than the left vein. It ſends off, firſt of all, four large branches, *viz.* the vertebralis, which is the firſt and moſt poſterior; the jugularis interna, jugularis externa, and axillaris.

The left ſubclavian ſeems to aſcend but very little after the bifurcation; and, in this courſe, it covers the origin of three large arteries, which come from the curvature of the aorta. It ſends off four large branches, beſides the ſmall pectoral veins, and receives the ductus thoracicus.

It likewiſe gives off, before its principal diviſion, a ſmall trunk for the left ſuperior intercoſtals, and this intercoſtal trunk furniſhes likewiſe the left bronchialis.

Each ſubclavian vein, near the middle of the clavicula, ſends off a branch, called cephalica, which deſcends near the ſurface of the body, between the deltoides and pectoralis major.

Each external jugular vein ariſes from the ſubclavian on the ſame ſide, ſometimes from the axillaris, and ſometimes from the union of theſe two veins. They run up between the muſculus cutaneus and ſterno-maſtoidæus.

Sometimes they are double from their very origins; and when they are ſingle, each of them divides afterwards into two, one anterior, and the other poſterior, or rather ſuperior, The anterior vein goes to the throat and face, running up toward the angle of the lower jaw, and the poſterior goes to the temples and occiput.

The anterior external jugular vein is often a branch of the jugularis interna, and ſometimes it comes from the vena axillaris.

It runs up toward the lateral part of the lower jaw, between the angle and the chin, and ſends ſeveral branches forwards, backwards, and inwards.

Poſteriorly it gives, (1.) A large branch on the ſide of the upper part of the larynx, which communicates with the jugularis interna, and likewiſe with a large ſhort branch of the jugularis externa poſterior. (2.) A ſmall branch, which has the ſame communication, but which is not always to be found. (3.) Another ſmall branch a little below the lower jaw, which communicates with the jugularis externa poſterior.

Anteriorly it ſends ſeveral branches to the muſcles of the larynx, ſterno-hyoidæi, thyro-hyoidæ, and to the integuments; and below the larynx it ſends communicating branches to the jugularis externa anterior of the other ſide.

A little higher, oppoſite to the cartilago-thyroides, it gives off a tranſverſe branch, which runs on the anterior and lower part of the muſculi ſterno-maſtoidæi, and communicates with the jugularis of the other ſide.

The ſuperior and inferior tranſverſe branches communicate on each ſide by branches more or leſs perpendicular, and ſend a ſmall branch to the muſculus quadratus of the chin, to the muſculus cutaneus and integuments.

It ſends another large branch anteriorly toward the ſymphyſis of the lower jaw, which, after having ſupplied the maxillary glands, is diſtributed to the digaſtric muſcle, to the chin and under lip.

Interiorly, at the ſame place, it ſends out a large branch, which furniſhes the glandulæ ſublinguales, runs down toward the cornua of the os hyoides, to communicate with ſome branches of the jugularis interna, and ſends ſeveral rami to the tongue, called *venæ raninæ*. It gives off likewiſe a ſmall branch, which running upon the muſculus labiorum triangularis, to the commiſſure of the lips, is diſtributed to the neighbouring parts.

The ſame branch which gives out the venæ raninæ, detaches another to the lateral parts of the ſeptum palati, which is diſtributed to the amygdalæ, and to the uvula, and ſends rami forward to the membrane which lines the arch of the palate. Another branch goes out from it to the pterygoidæus internus, periſtaphylini, and cephalopharyngæi.

Afterwards the trunk of the anterior external jugular vein runs up on the muſculus triangularis, where it receives the name of vena triangularis, in a winding courſe, from the angle of the lower jaw to the great or internal angle of the orbit, ſending branches on each ſide to the muſcles and integuments.

The trunk of the vena angularis having reached the bones of the noſe, ſends out a branch through the lateral cartilages of the noſe, which is diſtributed to the nares; and another which runs down in a winding courſe to the upper lip.

At the great or inner angle of the eye, the ſame trunk ſends off ſeveral other branches; the firſt of which goes to

to the root of the nose, and communicating with its fellow from the other side, gives several small veins to the holes of the ossa nasi.

The second branch runs up on the fore-head, by the name of *vena frontalis*, and is distributed to each side.

The third branch enters the orbit in a winding course, on one side of the cartilaginous pulley, and communicates with the sinuses of the dura mater, by the orbitary sinus of the eye.

The fourth branch goes along the musculus superciliaris and the upper part of the orbicularis, to the small or external angle of the eye, to communicate with the vena temporalis, and with that vein which runs along the lower part of the orbicular muscle.

The posterior or superior external jugular vein runs up toward the parotid gland, and lower anterior part of the eye, giving out several branches toward each side.

At its origin it sends out posteriorly, a principal branch, with its ramifications, to the muscles which cover the scapula and joint of the humerus, commonly called *vena muscularis*.

A little higher, it gives off the vena cervicalis, which goes to the vertebral muscles of the neck.

Near the cervical vein, but a little more outward, it gives off sometimes the small vena cephalica, which runs down between the pectoralis major and deltoides, and unites with the vena cephalica of the arm.

Backward it detaches the vena occipitalis, which is distributed on the occiput; it likewise sends out a small vein, which enters the cranium by the posterior mastoid hole, and terminates in one of the lateral sinuses of the dura mater.

Having reached as far as the parotid gland, it forms communications with the anterior external jugular, under the angle of the lower jaw; and then passes through the parotid gland, between that angle and the condyle, giving off a large branch which communicates with another branch common to the internal and anterior external jugulars.

Afterwards it passes before the ear, taking the name of *vena temporalis*, which is distributed to the temples and lateral parts of the head, towards the occiput and fore-head.

The temporal vein of one side communicates, above, with its fellow on the other side; before, with the vena frontalis; and behind, with the vena occipitalis. Opposite to the ear, it gives out a large branch, one ramus of which runs under the lower edge of the zygoma, and then returning, communicates with another ramus from the same jugularis, a little below the condyle of the lower jaw.

Behind this condyle, it gives branches to the temporal muscle, to the neighbouring parts of the upper jaw, and to the inside of the lower jaw.

The internal jugular vein is the largest of those that go to the head.

It runs up behind the sterno-mastoidæus and omo-hyoidæus, which it crosses, along the sides of the vertebræ of the neck, by the edge of the longus colli, to the fossula of the foramen lacerum of the basis cranii.

The first branches which it sends off are small, and go to the thyroid glands. About two fingers breadth higher up, it detaches a middle-sized branch, which runs laterally towards the larynx, and may be named *vena gutturalis*.

This guttural vein divides chiefly into three branches; the lowest of which goes to the thyroid gland and neighbouring muscles; the middle branch to the larynx, musculi thyroidæi, *&c.* and the third runs upward to the great communication between the two jugulares.

About the same distance upward, almost opposite to the os hyoides, the internal jugular gives another branch, which sends rami to the muscles belonging to that bone, and others which communicate with the foregoing branch. This other branch runs upward toward the parotid gland and angle of the lower jaw, where it sends communicating branches forward and backward to the two external jugulares.

The internal jugular sends another branch backward, which is distributed to the occiput, where it communicates with a branch of the vertebralis, and, through the posterior mastoid hole, with the lateral sinus of the dura mater.

Afterwards it reaches the foramen lacerum of the basis cranii, bending a little, and sending off small twigs to the pharynx and neighbouring muscles.

The vertebral vein arises posteriorly from the subclavia or axillaris, sometimes by two stems.

The first and principal stem gives out a branch, called *vena cervicalis*, which is distributed to the neighbouring muscles, and afterwards runs up through the holes of the transverse apophyses of the vertebræ colli.

The other stem of the vertebral vein runs up on the side of the vertebræ; and having reached the fourth, or sometimes higher, it runs in between the transverse apophyses of that vertebra and the fifth, to join the first or principal stem.

Thus the vertebral vein accompanies the artery of the same name, sometimes in one trunk, sometimes in several stems, through all the holes of the transverse apophyses of the vertebræ colli, all the way to the great foramen occipitale, communicating with the occipital veins and small occipital sinuses of the dura mater.

In its passage it gives off one branch, which enters by the posterior condyloid hole of the os occipitis, and communicates with the lateral sinus of the dura mater.

As these veins run through the holes in the transverse apophyses, they send branches forward to the anterior muscles of the neck, and to the small anterior muscles of the head.

Other branches go likewise outward and backward to the musculi transversales and vertebrales colli; and inward to the great canal of the spinal marrow, where they form sinuses, which communicate with those on the other side.

These vertebral sinuses are pretty numerous, and placed one above another all the way to the occiput; the lower communicate with the upper; and at the great foramen of the os occipitis there is a communication between them and the occipital sinuses of the dura mater.

The subclavian vein having sent off the branches already described, goes out of the thorax, and passes before

Plate XVII

A Bell Sculpt

fore the anterior portion of the musculus scalenus, and between the first rib and the clavicle, to the axilla. Through this course it takes the name of *vena axillaris*, and gives off several branches, the chief of which are the venæ musculares, thoracicæ, and vena cephalica.

The musculares, are distributed to the middle portion of the musculus trapezius, to the angularis, infra-spinatus, and subscapularis; and as some of these branches go to the shoulder exteriorly, others interiorly, the venæ scapulares are distinguished into external and internal.

A little before the axillaris reaches the axilla, it sends out the venæ thoracicæ, one of which is superior, called also *mammaria externa*, and the other inferior. It likewise sends rami to the musculus subscapularis, teres major, teres minor, supra-spinatus, latissimus dorsi, serratus major, pectoralis minor, pectoralis major, and to the glands of the axilla.

The axillaris having reached the side of the head of the os humeri, produces a branch, named *vena cephalica*, and afterwards runs along the arm by the name of *vena basilica*.

The cephalic vein, which is a branch of the axillaris, at a small distance from its origin, joins the small cephalica, which runs down from the subclavia, or jugularis externa.

The great cephalica runs down between the tendons of the last mentioned muscles, and along the outer edge of the external portion of the biceps; communicating several times with the vena basilica, and sending small rami on each side, to the neighbouring muscles, fat and skin.

A little below the external condyle of the os humeri, it detaches a branch backward, which runs up between the musculus brachialis and the upper portion of the supinator longus, and afterwards bends back between the os humeri and anconæus externus, where it communicates with some branches of the basilica.

Having reached very near the fold of the arm, it is divided into two principal branches, one long, the other short. The long branch is named *radialis externa*, and the short one may be called *mediana cephalica*, to distinguish it from another mediana, which is a short branch of the basilica.

The external radial vein runs along the radius between the muscles and integuments, giving off branches towards both sides, which communicate with other branches of the same vein, and with some from the basilica.

The mediana cephalica runs down obliquely toward the middle of the fold of the arm, under the integuments, and over the tendon of the biceps, where it joins a short branch of the same kind from the basilica.

From this anastomosis, a considerable branch goes out, which runs down on the fore-arm, uniting on one side with the vena cephalica, and communicating on the other with the basilica, by several irregular areolæ. The name of *mediana* is given to this large branch, as well as to the two short ones, by the union of which it is formed.

From this union of the two lateral medianæ, and sometimes from the origin of the mediana media, a branch goes out, which runs down on the inside of the fore-arm, opposite to the interrosseous ligament, and is called *vena cubiti profunda*. It goes to the neighbouring muscles, and communicates with the other veins of the fore-arm. The mediana cephalica sometimes sends down a long branch, called *radialis interna*, which lies almost parallel to the radialis externa.

Afterwards the cephalica, having reached the extremity of the radius, is distributed, by numerous areolæ, almost in the same course with the radial artery.

A particular branch goes out from it, which runs more or less superficially between the thumb and metacarpus, by the name of *cephalica pollicis*. The areolæ furnish the interrosseous muscles and integuments, and communicate with a small ramus from the basilica, called by the ancients *Salvatella*.

The basilic vein sends off first of all, under the head of the os humeri, a pretty large branch, which passes almost transversely round the neck of that bone, from within backward, and from behind outward, running upon the scapula, where it is ramified on the deltoides, and communicates with the venæ scapulares externæ. This branch may be named *vena sub-humeralis*, or articularis.

This articular vein sends down two principal branches, one of which runs along the inside of the bone, to which, and to the periosteum, it gives small veins. The other turns forward, toward the middle of the arm between the bone and the biceps, and communicates with the cephalica.

Below the neck of the os humeri, near the hollow of the axilla, and behind the tendon of the pectoralis major, the basilica sends out a considerable branch, which runs down on the side of the brachial artery, and furnishes the neighbouring muscles on both sides. This vein is named *profunda brachii*.

Immediately afterwards, the basilica detaches two or three small veins, which run down very closely joined to the brachial artery, surrounding it at different distances by small twigs which communicate with each other.

These small veins, which often arise from the profunda superior, communicate with the basilica and cephalica; and having reached the fold of the arm, they divide like the artery; and the same divisions are continued along the whole fore-arm.

Afterwards the basilica continues its course along the inside of the os humeri, between the muscles and integuments, forming many communications with the vena profunda and cephalica, and supplying the muscles and integuments.

Having reached the inner condyle, and having sent off obliquely, in the fold of the arm, the mediana basilica, it runs along the ulna, between the integuments and muscles, a little toward the outside, by the name of *cubitalis externa*.

The basilica having at length reached the extremity of the ulna, sends several branches to the convex side of the carpus; one of which, named *Salvatella*, goes to that side of the little finger next the ring finger, having first communicated with the cephalica, by means of the venal areolæ conspicuous on the back of the hand. In the other fingers this vein follows nearly the same course with the arteries.

In general, the external or ſuperficial veins of the fore-arm are larger than the internal.

The inferior Vena Cava having run down about a quarter of an inch from the right auricle of the heart, within the pericardium, pierces that membrane and the tendinous portion of the diaphragm.

At this place it gives off the venæ diaphragmaticæ, or phrenicæ, which are diſtributed to the diaphragm, and appear chiefly on its lower ſide, one towards the right hand, and one towards the left. The right vein is more backward and lower than the left. The left is diſtributed partly to the pericardium, and partly to the diaphragm; and ſometimes they ſend rami to the capſulæ renales.

The inferior cava having perforated the diaphragm, paſſes through the poſterior part of the great fiſſure of the liver, penetrating a little into the ſubſtance of that viſcus, between the great lobe and the lobulus Spigelii.

In its paſſage, it ſends off commonly three large branches, called *venæ hepaticæ*, which are ramified in the liver.

Beſides theſe large branches, it ſends out ſome other ſmall ones, either before or immediately after it goes out of the liver.

In the fœtus, as the vena cava paſſes by the liver, it gives off the ductus venoſus, which communicates with the ſinus of the vena portæ; and in adults is changed to a flat ligament.

After its paſſage through the liver, the vena cava turns from before backward, and from right to left, toward the ſpina dorſi, placing itſelf on the right ſide of the aorta, which it accompanies from thence downward.

Having got as low as the arteriæ renales, it gives off the veins of the ſame name, termed formerly *venæ emulgentes*.

The right renal runs down a little obliquely, becauſe of the ſituation of the kidney. The left vein croſſes on the foreſide of the trunk of the aorta, immediately above the ſuperior meſenteric artery.

They ſend up the venæ capſulares, which go to the glandulæ renales, and downward; the venæ adipoſæ, which go to the fatty covering of the kidneys; and ordinarily the left renal vein furniſhes the left ſpermatic vein. Afterwards they run to the ſinus, or cavity of the kidneys, in the ſubſtance of which they are diſtributed by numerous ramifications.

A little below the renal veins, the trunk of the cava ſends out anteriorly, toward the right ſide, the right vena ſpermatica. The left ſpermatic vein comes commonly from the left renalis.

In their paſſage, they ſend ſeveral ſmall branches on each ſide, to the peritonæum and meſentery, where they ſeem to be joined by anaſtomoſes with the venæ meſaraicæ.

The cava ſends likewiſe off poſteriorly the venæ lumbares, which commonly ariſe in pairs. Theſe may be divided into ſuperior and inferior veins.

Their origins vary in different manners. Sometimes the cava gives off a branch to each ſide below the firſt vertebra of the loins, which, like a common trunk, furniſhes the lumbar veins. This branch communicates with the azygos.

Sometimes a conſiderable branch goes out from the lower extremity of the cava, near the bifurcation, chiefly on the right ſide, which afterwards running up between the bodies and tranſverſe apophyſes of the vertebræ, detaches the venæ lumbares, and communicates with the azygos.

Sometimes a like branch comes from the beginning of the left vena iliaca, and, running up on that ſide in the ſame manner, produces the lumbares.

The venæ lumbares on one ſide communicate by tranſverſe branches with thoſe of the other ſide, and likewiſe with each other by branches more or leſs longitudinal. The firſt and ſecond often go from the azygos, and thereby they communicate with the intercoſtal veins.

The lumbar veins ſend ſmall capillaries, in their paſſage, to the ſubſtance of the bodies of the vertebræ; and they are diſtributed to the muſcles of the abdomen, quadratus lumborum, pſoas, iliacus, *&c.* They ſend branches backward to the neighbouring vertebral muſcles, and to the canal of the ſpine, and communicate with the venal ſinuſes.

The inferior cava, having reached as low as the laſt vertebra of the loins, and near the bifurcation of the aorta, runs in behind the right iliac artery, and there is divided into two ſubaltern trunks, called the *right and left iliac veins*.

From this bifurcation of the vena cava, the vena ſacra goes out, and accompanies the artery of the ſame name in its diſtribution to the os ſacrum, to the nerves which lie there, and to the membranes which cover both ſides of that bone.

Each original iliac vein is divided on the ſide of the os ſacrum, much after the ſame manner as the arteries, into two large trunks.

One of theſe trunks is named *vena iliaca externa* or *anterior*; the other *interna* or *poſterior*.

Theſe veins follow nearly the courſe and diſtribution of the iliac arteries, except that the hypogaſtric vein does not ſend off the vena umbilicalis.

From the common trunk of the iliac veins, and ſometimes from the origin of the iliaca externa, a particular branch goes out, which is diſtributed to the muſculus pſoas, iliacus, and quadratus lumborum; and afterwards ſends a ramus on the fore-ſide of the laſt tranſverſe apophyſis of the loins, to communicate with the laſt lumbar vein.

The external iliac, a little before it leaves the abdomen, near the ligamentum Fallopii, lying on the pſoas and iliac muſcles, gives off almoſt the ſame branches with the artery of the ſame name, and follows the ſame courſe. The chief branches are theſe:

A little before it goes out of the abdomen, it ſends off from the outſide, a ſmall branch, which runs up along the criſta of the os ilium, and gives branches on each ſide to the lateral and poſterior lower portions of the muſculi abdominis, to the muſculus iliacus, *&c.*

From the inſide, before it leaves the abdomen, it ſends off the vena epigaſtrica; which having furniſhed ſome ſmall rami to the neighbouring conglobated glands, runs up along the inſide of the muſculi recti, on which it is ramified both ways.

Afterwards

Afterwards the vena epigaſtrica runs upward, and joins the ramifications of the mammaria.

Before the iliac vein gets from under the ligamentum Fallopii, it ſends ſeveral ſmall rami to the neighbouring lymphatic glands ; and immediately afterwards, loſing the name of iliaca, it takes that of *cruralis*.

The hypogaſtric, or internal iliac vein, runs behind the iliac artery, from which the following branches go out.

From the poſterior or convex part of the arch, it gives a branch to the ſuperior lateral part of the os ſacrum, which is diſtributed to the muſculus ſacer, or tranverſo-ſpinalis lumborum, and other muſcles thereabouts, and to the cavity of the bone, which it enters through the firſt great hole.

A little lower, on the ſame ſide, it ſends out another, which is diſtributed much in the ſame manner with the former, and enters the ſecond hole.

From the external lateral part of the ſame arch, a little anteriorly, it ſends out a large branch, which runs behind the great ſciatic ſinus, and is diſtributed to the muſculi glutæi, pyriformis, and gemelli.

Lower down, the ſame lateral part of the hypogaſtric vein gives out another large branch, called *obturatrix*; which, having run a little way, detaches ſeveral rami, and afterwards reaching the foramen ovale of the os innominatum, perforates the obturator muſcles, communicates with the vena cruralis, and is diſtributed to the muſculus pectineus, triceps, and neighbouring parts.

Among the branches ſent off by the vena obturatrix, before it perforates the muſcles, one is ſituated exteriorly, which runs toward the ſciatic ſinus, to the muſculus iliacus, the ſuperior part of the obturator internus, and to the os ilium.

Interiorly, the ſame obturator vein ſends off another branch, which is diſtributed to the ureters, bladder, and internal parts of generation in both ſexes.

Laſtly, the hypogaſtric vein runs backward, and goes out of the pelvis, above the ligament which lies between the inferior lateral part of the os ſacrum and ſpine of the iſchium.

It next ſends a large branch upward to the lower part of the os ſacrum, and two or more downward ; which, running behind the ſame ligament, are diſtributed to the buttocks, anus, neighbouring portion of the muſculus pectineus, and to the external parts of generation.

The veins that go to the anus, are termed *hæmorrhoidales externæ;* they that go to the parts of generation, *pudicæ internæ*. The external hæmorrhoidales communicate with the internal veins of the ſame name, which come from the ſmall vena meſaraica.

The crural vein goes out under the ligamentum Fallopii, on the inſide of the crural artery, and immediately gives ſmall branches to the inguinal glands, the muſculus pectineus, and parts of generation. Theſe laſt are termed *pudicæ externæ*, and evidently communicate with the internal veins of the ſame name.

About an inch below, where it leaves the abdomen, the crural vein produces a large branch, which runs down anteriorly between the integuments and the ſartorius, following the direction of that muſcle almoſt all the way to the inſide of the thigh.

This branch having afterwards got beyond the condyles of the os femoris, runs down between the integuments and inner angle of the tibia, to the fore-part of the inner ankle, and is diſtributed to the foot. All this large branch is named *vena ſaphena*, or *ſaphena major*.

After the origin of the ſaphena, as the trunk of the crural veins runs down, it ſinks in between the muſcles, and is diſtributed to all the inner or deep parts of the lower extremity, accompanying the crural artery to the very extremity of the foot.

As the ſaphena is a vein of very large extent, we ſhall here deſcribe it altogether, and afterwards return to the vena cruralis.

The vena ſaphena, in its paſſage from the inguen to the foot, is covered only by the ſkin and fat. Immediately after its riſe, it gives ſmall veins to the inferior inguinal glands; and then it gives out others more anteriorly, which, running under the integuments, communicate with each other by numerous areolæ.

The ſaphena, having run down on the thigh, as low as the middle of the ſartorius, ſends off to the ſame ſide ſeveral branches, which communicate with each other, and with the ſuperior branches.

Between theſe upper and lower branches, the ſaphena ſends backward a particular branch; which, after being diſtributed to the integuments which cover the gracilis internus and triceps, turns backward; and a little below the ham, runs in among the muſcles ſituated there, and communicates with another branch, which may be termed *ſaphena minor*.

Afterwards the trunk of the great ſaphena runs down on the inſide of the tibia, lying always near the ſkin; and at the upper part of that bone it ſends branches foreward, outward, and backward.

The anterior branches go to the integuments on the upper part of the leg; the poſterior, to thoſe which cover the gaſtrocnemii, and communicate with the little ſaphena; and the external branches are likewiſe diſtributed to the fat and integuments, and having reached as low as the middle of the tibia, it ſends a communicating branch to the trunk of the great ſaphena.

From this communication, a branch goes out anteriorly, which runs along the integuments of the tibia all the way to the outer ankle.

As the ſaphena runs down on the inſide of the tibia, it ſends out a branch near the middle of that bone, which runs up behind the tendons of the ſartorious, gracilis internus, and ſemi-nervoſus, then between the tibia and upper end of the ſoleus, and is joined by an anaſtomoſis with the crural vein.

At the lower part of the tibia, the ſaphena produces a conſiderable branch, which runs obliquely forward over the joint of the tarſus toward the outer ankle, ſending off ſeveral rami which communicate with each other, and with the trunk of the ſaphena.

The extremity of this trunk paſſes on the foreſide of the inner ankle, and runs irregularly under the ſkin, along

long the interftice between the firft two metatarfal bones toward the great toe, where this vein terminates.

The crural vein, having fent off the faphena, and the fmall branches for the pectineus, *&c.* as has been faid, runs down on the thigh behind the crural artery. Oppoiite to the little trochanter, it produces two large fhort branches, or one which afterwards divides into two, whereof one is anterior, the other pofterior.

The anterior branch runs more or lefs tranfverfely forward, to be diftributed to the vaftus internus, lower part of the pectineus, and of the fecond triceps, and to the other two mufcles of the fame name, running in between them as it goes from one to another.

The pofterior branch runs more or lefs tranfverfely backward, and furnifhes the glutæi, vaftus externus, and beginning of the biceps.

A little below thefe two branches, about the upper extremity of the vaftus internus, the crural vein produces a branch which runs down on the fide of the trunk, covering the crural artery, almoft as low as the ham, where it is again united to the trunk by an anaftomofis. It has the name of *vena fciatica*, from the fciatic nerve which it accompanies.

On the outfide of this anaftomofis, the crural vein gives off a branch which runs backward between the biceps and neighbouring mufcles, and fo downward on the backfide of the leg a little exteriorly, and very near the fkin, all the way to the outer ankle. This vein is termed *faphena minor*, or *externa*.

The little faphena, having got near the integuments in its courfe downward, gives out a branch which runs backward, and communicates with the great faphena about the middle of the backfide of the thigh.

Immediately above and below the ham, this vein fends out other branches, which likewife communicate with the faphena major, and, having run down about one third part of the backfide of the tibia, it fends off another branch, which is afterwards re-united to the trunk.

About the beginning of the tendo-achillis, the little faphena runs outward in the integuments, toward the outer ankles, where it terminates in cutaneous ramifications fent to every fide.

The crural vein, having detached the little faphena, runs down between the biceps and the other flexors of the leg, clofely accompanied by the crural artery, between which and the inner condyle of the os femoris it is fituated.

A little above the ham, it takes the name of *vena poplitea*; and as it runs down betwixt the two condyles, it gives branches to the flexor mufcles, to the lower and pofterior parts of both vafti, and to the fat which lies above the interftices of the two condyles.

It likewife gives off feveral other branches, one of which runs up laterally between the outer condyle and the biceps, and then turning forward, is ramified in the fame manner with the artery.

The vena poplitea runs down immediately behind the mufcle of the fame name, at the lower part of which it fends off feveral ramifications to each fide, which divide and unite again in different ways; and afterwards it lofes its name, being divided into three confiderable branches, called *tibialis anterior*, *tibialis pofterior*, and *peronæa*.

The anterior tibial vein, having diftributed fome fmall branches from its very beginning to the mufcles behind the heads of the two bones of the leg, perforates the interoffeous ligament from behind, forward, and runs between the fuperior portions of the mufculus tibialis anticus, and extenfor digitorum communis.

As foon as it pierces the interoffeous ligament, it diftributes fmall fuperficial branches to the head of the tibia and fibula, which run to the joint of the knee, and communicate with the lateral branches of the vena poplitea.

Afterwards it divides into two or three branches, which run down together on the forefide of the interoffeous ligament in company with the anterior tibial artery, which they furround at different diftances, by fmall communicating circles.

Thefe branches having reached the lower extremity of the leg, unite in one, which afterwards divides into feveral, the ramifications of which are diftributed to the foot.

The pofterior tibial vein gives off, from its beginning, a branch toward the infide, which is diftributed to the gaftrocnemii and foleus. This vein is named *furalis*.

Afterwards the pofterior tibialis runs down between the foleus and tibialis pofticus, giving branches to each of them. It is divided in the fame manner as the tibialis anterior, into two or three branches, which, as they run, furround the correfponding artery, by fmall communicating circles formed at different diftances.

It continues this courfe in company with the artery as low as the outer ankle, furnifhing the mufculus tibialis pofticus, and the long flexors of the toes.

Laftly, it paffes on the infide of the os calcis, under the fole of the foot, where it forms the venæ plantares, by dividing into feveral tranfverfe arches, which communicate with each other, and with the faphena, and fend ramifications to the toes.

The vena peronæa is likewife double, and fometimes triple. It runs down on the infide of the fibula, which it likewife furrounds at different diftances, by communicating branches, after the manner of the tibialis pofterior.

It runs down as low as the outer ankle, communicating feveral times with the tibialis pofterior, and fending ramifications to the neighbouring portions of the mufculi peronæi, and long flexors of the toes.

The vena portæ is a large vein, the trunk of which is fituated chiefly between the eminencies on the lower or concave fide of the liver.

It may be confidered as made up of two large veins, joined almoft endwife by their trunks, from each of which the branches and ramifications go out in oppofite directions. One of thefe trunks adheres to the liver, and is ramified in that vifcus, its branches accompanying the whole diftribution of the hepatic artery.

The other trunk is without the liver, and fends its branches to the vifcera, fupplied by the reft of the arteria cœliaca, and by the two mefentericæ, that is, to the ftomach, inteftines, pancreas, fpleen, mefentery, and omentum.

The firft portion of this vein may be termed *vena*

portæ

portæ hepatica, superior or *minor*, the trunk of which is commonly known by the name of *sinus venæ portarum*. The other portion may be called *vena portæ ventralis, inferior* or *major*.

The large trunk of the vena portæ inferior, or ventralis, is situated under the lower or concave side of the liver, and joined by an anastomosis to the sinus of the vena portæ hepatica, between the middle and right extremity of that sinus. From thence it runs down a little obliquely from right to left, behind or under the trunk of the arteria hepatica, bending behind the beginning of the duodenum, and under the head of the pancreas.

Having reached to the head of the pancreas, this trunk loses the general name of *vena portæ*, and terminates in three large principal branches, which are distributed, by numerous ramifications, to the viscera already named. The first branch is termed *vena mesaraica*, or *mesaraica major*; the second, *splenica*; and the third, *hæmorrhoidalis interna*, or *mesaraica minor*.

The vena mesaraica major appears to be a continuation of the trunk of the vena portæ inferior. The splenica is a capital branch of that trunk; and the hæmorrhoidalis interna has sometimes a common origin with the splenica.

The inferior vena portæ, before the formation of these three branches, sends off from the trunk several small rami, which are commonly the venæ cysticæ, hepatica minor, pylorica, duodenalis, and sometimes the gastrica recta, and coronaria ventriculi.

All these small veins sometimes arise separately; and, in other subjects, some of them go out by small common trunks.

The cystic veins run along the vesicula fellis, from its neck to the bottom; and as they are often no more than two in number, they are called *cysticæ gemellæ*.

The small hepatic vein is commonly a branch of one of the cysticæ.

The vena pylorica arises from the great trunk, almost opposite to the origin of the cysticæ; and sometimes is only a branch of the right gastrica. It passes over the pylorus to the short arch of the stomach, where it is joined, by anastomosis, with the coronaria ventriculi.

The duodenal vein, commonly called *vena intestinalis*, goes out from the great trunk near the cysticæ, and sometimes from the small common trunk of these veins. It is distributed chiefly to the intestinum duodenum, and sends likewise some rami to the pancreas.

The inferior vena portæ, having given off the splenica, changes its name to that of *mesaraica*, or *mesaraica major*; which often appears to be rather a continuation of the trunk, than of one of the great branches.

It bends toward the superior mesenteric artery, sending off two veins, and afterwards running up over that artery, it accompanies it in those portions of the mesentery and mesocolon which belong to the small intestines, the cæcum, and right portion of the colon.

The first particular branch from this trunk is called *vena colica*. It goes out from the anterior part of the trunk, before it joins the artery, and runs directly to the middle of the colon, where it divides to the right and left, and forms arches. On the left hand, it communicates with the superior or ascending branch of the hæmorrhoidalis; and on the right, with the second branch of the mesaraica.

This second branch is a little under the first, or colica anterior, and something more towards the right hand. It may be named *gastro-colica*, and is soon divided into two branches, one superior, the other inferior.

The superior branch of the vena gastro-colica sends small veins to the head of the pancreas, and forms the vena gastrica, or gastro-epiploica dextra, which goes from the pylorus to the great curvature of the stomach, and communicates with the gastrica sinistra. In its passage it supplies the stomach and omentum, and communicates with the pylorica, coronaria ventriculi, *&c.*

The inferior branch of the vena gastro-colica, which may be called *colica dextra*, goes to the right portion of the colon; and from thence to the upper part of that intestine, where it is divided archwise, and communicates with the right branch of the colica anterior, and with a branch of the vena cæcalis.

The trunk of the great mesaraic vein sends out sometimes, opposite to the gastrica, a particular branch to the omentum, called *epiploica dextra*. But almost immediately before it ascends over the mesenteric artery, it produces two large branches very near each other, which pass behind and under the artery, being distributed to the jejunum and part of the ilium by numerous ramifications.

Afterwards the trunk of the mesaraic passes over the superior mesenteric artery, to which it adheres very closely, and from the convex side of its arch sends out several branches, almost in the same manner with the artery.

From the concave side of the mesaraic vein, a little below the origin of the second branch, from the convex side, arises a branch, called *vena cæcalis*, which runs to the beginning of the colon, crossing one of the branches of the superior mesenteric artery.

This cæcal vein divides by two arches, the uppermost of which communicates with the lower branch of the vena gastro-colica; the other, after having sent ramifications to the intestinum cæcum and appendicula vermiformis, communicates below with the extremity of the great mesaraic vein.

The splenic vein is one of the three great branches of the vena portæ. It runs transversely from the right to the left, first under the duodenum, and then along the lower side of the pancreas.

In this course it gives off several veins, *viz.* the vena coronaria ventriculi, pancreaticæ, gastrica, or gastro-epiploica sinistra, and epiploica sinistra. It likewise often gives origin to the hæmorrhoidalis interna, the third capital branch of the vena portæ.

It terminates afterwards by a winding course, being divided into several branches that go to the spleen; one of which produces the small veins called, by the ancients, *vasa brevia*.

The coronaria ventriculi runs along the small arch of that viscus toward the pylorus, where it joins and becomes continuous with the vena pylorica. In its passage, it gives several rami to the sides of the stomach.

The venæ pancreaticæ are several small branches sent

fent by the fplenica to the pancreas, along its lower fide.

The left gaftric, or gaftro-epiploic vein, goes out from the fplenica, at the left extremity of the pancreas; from whence it runs to the great extremity of the ftomach, and along the great arch, till it meets the gaftrica dextra, which is continuous with the finiftra.

In its paffage, it gives feveral branches to both fides of the ftomach, which are diftributed by numerous ramifications, form many areolæ, and communicate with the branches of the coronaria ventriculi.

At a fmall diftance from its origin, this gaftric vein fends out a branch, which is diftributed to the omentum; and on this account it has been called *gaftro epiploica*.

The vena epiploica finiftra arifes at the fmall extremity of the pancreas, and is ramified on the omentum, all the way to the colon, where it communicates with the hæmorrhoidalis interna.

Laftly, the vena fplenica reaches the fiffure of the fpleen, which it enters through its whole length by feveral branches. It is from the moft pofterior of thefe branches that the veins are fent off to the great extremity of the ftomach, formerly known by the name of *vafa brevia*, which communicate with the coronaria ventriculi and gaftrica finiftra.

The internal hæmorrhoidal vein is one of the three great branches of the vena portæ, coming ordinarily from the beginning of the vena fplenica, and fometimes from the extremity or angle of the bifurcation of the great trunk of the vena portæ.

At a fmall diftance from its beginning, it gives to the duodenum a fecond vena duodenalis.

Afterwards it is divided into two branches, one fuperior or afcending, the other inferior or defcending. The firft runs to the upper part of the arch of the colon, where, after many ramifications, it communicates with a branch of the great mefaraica, with the ramifications of the gaftro-epiploica finiftra, and with thofe of the neighbouring epiploica.

The inferior branch runs down on the left portion of the colon, on the lower incurvations of that inteftine, and on the rectum, all the way to the anus. In this courfe, it fupplies the mefocolon, and forms arches, which fend out numerous fmall ramifications, which furround thefe inteftines.

This vein has been named *hæmorrhoidalis*, from the tumours often found at its extremity next the anus, which are called *hæmorrhoides*. The word *interna* is added, to diftinguifh this vein from the hæmorrhoidalis externa, which comes from the vena hypogaftrica, and with which this vein communicates by capillary ramifications.

EXPLANATION OF PLATE XVII.

This plate reprefents the heart in fitu, all the large arteries and veins, with fome of the mufcles, *&c.*

Muscles.—Superior Extremity.—a, Maffeter. b, Complexus. c, Diagaftricus. d, Os hyoides. e, Thyroid gland. f, Levator fcapulæ. g, Cucullaris. h h, The clavicles cut. i, The deltoid mufcle. k, Biceps flexor cubiti cut. l, Coraco-brachialis. m, Triceps extenfor cubiti. n, The heads of the pronator teres, flexor carpi radialis, and flexor digitorum fublimis, cut. o, The flexor carpi ulnaris, cut at its extremity. p, Flexor digitorum profundus. q, Supinator radii longus, cut at its extremity. r, Ligamentum carpi tranfverfale. s, Extenfores carpi radiales. t, Latiffimus dorfi. u, Anterior edge of the ferratus anticus major. v, v, The inferior part of the diaphragm. w w, Its anterior edge cut. x x, The kidneys. y, Tranfverfus abdominis. z, Os ilium.

Inferior Extremity.—*a*, Pfoas magnus. *b*, Iliacus internus. *c*, The flefhy origin of the tenfor vaginæ femoris. *d d*, The offa pubis cut from each other. *e*, Mufculus pectineus cut from its origin. *f*, Short head of the triceps adductor femoris cut. *g*, The great head of the triceps. *h*, The long head cut. *i*, Vaftus internus. *k*, Vaftus externus. *l*, Crureus. *m*, Gemellus. *n*, Soleus. *o*, Tibia. *p*, Peronæus longus. *q*, Peronæus brevis. *r*, Fibula.

Heart and Blood-Vessels.—A, The heart, with the coronary arteries and veins. B, The right auricle of the heart. C, The aorta afcendens. D, The left fubclavian artery. E, The left carotid artery. F, The common trunk which fends off the right fubclavian and right carotid arteries. G, The carotis externa. H, Arteria facialis, which fends off the coronary arteries of the lips. I, Arteria temporalis profunda. K, Aorta defcendens. L L, The iliac arteries,—which fend off M M, The femoral or crural arteries. *N. B.* The other arteries in this figure have the fame diftribution as the veins of the fame name:—And generally, in the anatomical plates, the defcription to be found on the one fide, points out the fame parts in the other. 1, The frontal vein. 2, The facial vein. 3, Vena temporalis profunda. 4, Vena occipitalis. 5, Vena jugularis externa. 6, Vena jugularis interna, covering the arteria carotis communis. 7, The vafcular arch on the palm of the hand, which is formed by 8, the radial artery and vein, and 9, the ulnar artery and vein. 10 10, Cephalic vein. 11, Bafilic vein, that on the right fide, cut. 12, Median vein. 13, The humeral vein, which, with the median, covers the humeral artery. 14 14, The external thoracic, or mammary arteries and veins. 15, The axillary vein, covering the artery. 16 16, The fubclavian veins, which, with (6 6) the jugulars, forms 17, the vena cava fuperior. 18, The cutaneous arch of veins on the fore-part of the foot. 19, The vena tibialis antica, covering the artery. 20, The vena profunda femoris, covering the artery. 21, The upper part of the vena faphena major. 22, The femoral vein. 23 23, The iliac veins. 24, 24, Vena cava inferior. 25 25, The renal veins covering the arteries. 26 26, The diaphragmatic veins.

PART

PART V.

OF THE NERVES.

Sect. I. *Of the* Nerves *in general.*

THE medullary ſubſtance of the brain is employed in forming the white fibrous cords, which are called *nerves*. Within the ſkull we ſee the nerves to be the medullary ſubſtance continued; and the ſpinal marrow is all employed in forming nerves.

The nerves are compoſed of a great many threads, lying parallel to each other, or nearly ſo, at their exit from the medulla.

This fibrous texture is evident at the origin of moſt of the nerves within the ſkull; and in the cauda equina of the ſpinal marrow we can divide them into ſuch ſmall threads, that a very good eye can ſcarce perceive them; but theſe threads, when looked at with a microſcope, appear each to be compoſed of a great number of ſmaller threads.

How ſmall one of theſe fibrils of the nerves is, we know not; but when we conſider that every, even the moſt minute part of the body is ſenſible, and that this muſt depend on the nerves, (which all conjoined would not make a cord of an inch diameter), being divided into branches or filaments to be diſperſed through all theſe minute parts, we muſt be convinced, that the nervous fibrils are very ſmall.

The medullary ſubſtance, of which the nervous fibrils are compoſed, is very tender, and would not be able to reſiſt ſuch forces as the nerves are expoſed to within the bones, nor even the common force of the circulating fluids, were not the pia mater and tunica arachnoides continued upon them; the former giving them firmneſs and ſtrength, and the latter furniſhing a cellular coat to connect the threads of the nerves, to let them lie ſoft and moiſt, and to ſupport the veſſels which go with them.

It is this cellular ſubſtance that is diſtended when air is forced through a blow-pipe thruſt into a nerve, and that makes a nerve appear all ſpongy, after being diſtended with air till it dries; the proper nervous fibrils ſhriveling ſo in drying, that they ſcarce can be obſerved.

Theſe coats would not make the nerves ſtrong enough to bear the ſtretching and preſſure they are expoſed to in their courſe to the different parts of the body; and therefore, where the nerves go out at the holes in the cranium and ſpine, the dura mater is generally wrapt cloſely round them, to collect their diſgregated fibres into tight firm cords; and that the tenſion which they may happen to be expoſed to may not injure them before they have got this additional coat, it is firmly fixed to the ſides of the holes in the bones through which they paſs.

The nervous cords, thus compoſed of nervous fibrils, cellular coat, pia and dura mater, have ſuch numerous blood-veſſels, that, after their arteries only are injected, the whole cord is tinged of the colour of the injected liquor.

A nervous cord has very little elaſticity, compared with ſeveral other parts of the body. When cut out of the body, it does not become obſervably ſhorter, while the blood-veſſels contract three eighths of their length.

Nerves are generally lodged in a cellular or fatty ſubſtance, and have their courſe in the interſtices of muſcles, where they are guarded from preſſure; but in ſeveral parts they are ſo placed, as if it was intended that they ſhould there ſuffer the vibrating force of arteries, or the preſſure of the contracting fibres of muſcles.

The larger cords of the nerves divide into branches as they go off to the different parts; the branches being ſmaller than the trunk from which they come, and making generally an acute angle where they ſeparate.

In ſeveral places, different nerves unite into one cord, which is commonly larger than any of the nerves which form it. Several nerves, particularly thoſe which are diſtributed to the bowels, after ſuch union, ſuddenly form a hard knot conſiderably larger than all the nerves of which it is made. Theſe knots were formerly called *corpora olivaria*, and are now generally named *ganglions*.

The ganglions have thicker coats, more numerous and larger blood-veſſels than the nerves; ſo that they appear more red and muſcular.

Commonly numerous ſmall nerves, which conjunctly are not equal to the ſize of the ganglion, are ſent out from it, but with a ſtructure no way different from that of other nerves.

The nerves ſent to the organs of the ſenſes, loſe there their firm coats, and terminate in a pulpy ſubſtance. The optic nerves are expanded into the ſoft tender webs, the retinæ. The auditory nerve has ſcarce the conſiſtence of mucus in the veſtibulum, cochlea, and ſemicircular canals of each ear. The papillæ of the noſe, tongue, and ſkin, are very ſoft.

The nerves of muſcles can likewiſe be traced till they ſeem to loſe their coats by becoming very ſoft; from which, and what we obſerved of the ſenſatory nerves, there is reaſon to conclude, that the muſcular nerves are alſo pulpy at their terminations, which we cannot indeed proſecute by diſſection.

Sect.

Sect. II. *Of the particular* Nerves.

It is generally ſaid, that there are forty pair of nerves in all; of which ten come out from the encephalon, and the other thirty have their origin from the ſpinal marrow.

Of the ten pair of nerves which come from the encephalon, the *firſt* is the Olfactory, which have their origin from the corpora ſtriata, near the part where the internal carotid arteries are about to ſend off their branches to the different parts of the brain; and in their courſe under the anterior lobes of the brain, which have each a depreſſion made for lodging them, become larger, till they are extended to the cribriform bone; where they ſplit into a great number of ſmall filaments, to paſs through the little holes in that bone; and being joined by a branch of the fifth pair of nerves, are ſpread on the membrane of the noſe.

The tender ſtructure and ſudden expanſion of theſe nerves on ſuch a large ſurface, render it impoſſible to trace them far; which has made ſome authors deny them to be nerves: But when we break the circumference of the cribriform lamella, and then gently raiſe it, we may ſee the diſtribution of the nerves ſome way on the membrane of the noſe.

The contrivance of defending theſe long ſoft nerves from being too much preſſed by the anterior lobes of the brain under which they lie, is ſingular; becauſe they have not only the prominent orbitar proceſſes of the frontal bone to ſupport the brain on each ſide, with the veins going into the longitudinal ſinus, and other attachments bearing it up, but there is a groove formed in each lobe of the brain itſelf for them to lodge in.—Their ſplitting into ſo many ſmall branches before they enter the bones of the ſkull, is likewiſe peculiar to them; for generally the nerves come from the brain in diſgregated filaments, and unite into cords, as they are going out at the holes of the bones. This contrivance is the beſt for anſwering the purpoſe they are deſigned for, of being the organ of ſmelling; for had they been expanded upon the membrane of the noſe into a medullary web, ſuch as the optic nerve forms, it would have been too ſenſible to bear the impreſſions of ſuch objects as are applied to the noſe; and a diſtribution in the more common way, of a cord ſending off branches, would not have been equal enough for ſuch an organ of ſenſation.

The *ſecond* pair of nerves, the Optic, riſing from the thalami nervorum opticorum, make a large curve outwards, and then run obliquely inwards and forwards, till they unite at the fore-part of the ſella turcica; then ſoon divide, and each runs obliquely forwards and outwards to go out at its proper hole in the ſphenoid bone, accompanied with the ocular artery, to be extended to the globe of the eye, within which each is expanded into a very fine cuplike web, that lines all the inſide of the eye as far forwards as the ciliary circle, and is univerſally known by the name of Retina.

Though the ſubſtance of this pair of nerves ſeems to be blended at the place where they are joined; yet obſervations of people whoſe optic nerves were not joined, and of others who were blind of one eye from a fault in the optic nerve, or in thoſe who had one of their eyes taken out, make it appear, that there is no ſuch intimate union of ſubſtance; the optic nerve of the affected ſide only being waſted, while the other was large and plump. And the ſame obſervations are contradictory to the doctrine of a decuſſation of all the nerves, for the diſeaſe could be traced from the affected eye to the origin of the nerve on the ſame ſide.

Theſe people whoſe optic nerves were not joined, having neither ſeen objects double, nor turned their eyes different ways, is alſo a plain proof, that the conjunction of the optic nerves will not ſerve to account for either the uniform motions of our eyes, or our ſeeing objects ſingle with two eyes.

The retina of a recent eye, without any preparation, appears a very fine web, with ſome blood-veſſels coming from its center to be diſtributed on it; but, after a good injection of the arteries that run in the ſubſtance of this nerve, as is common to other nerves, it is with difficulty that we can obſerve its nervous medullary ſubſtance. —The ſituation of theſe veſſels in the central part of the optic nerve, the want of medullary fibres here, and the firmneſs of this nerve before it is expanded at its entry into the ball of the eye, may be the reaſon why we do not ſee ſuch bodies, or parts of bodies, whoſe picture falls on this central part of the retina.

The Third Pair riſe from the anterior part of the proceſſus annularis, and piercing the dura mater a little before, and to a ſide of the ends of the poſterior clinoid proceſs of the ſphenoid bone, run along the receptacula, or cavernous ſinuſes, at the ſide of the ephippium, to get out at the foramina lacera; after which each of them divides into branches, of which one, after forming a little ganglion, is diſtributed to the globe of the eye; the others are ſent to the muſculus rectus of the palpebra, and to the attollens, adductor, deprimens, and obliquus minor muſcles of the eye-ball. Theſe muſcles being principal inſtruments in the motions of the eye-lid and eye-ball, this nerve has therefore got the name of the Motor Oculi.

The Fourth Pair, which are the ſmalleſt nerves of any, derive their origin from the back-part of the baſe of the teſtes; and then making a long courſe on the ſide of the annular protuberance enter the dura mater a little farther back, and more externally than the third part, to run alſo along the receptacula, to paſs out at the foramina lacera, and to be entirely ſpent on the muſculi trochleares, or ſuperior oblique muſcles of the eyes. Theſe muſcles being employed in performing the rotatory motions, and the advancement of the eye-balls forward, by which ſeveral of our paſſions are expreſſed, the nerves that ſerve them have got the name of Pathetici.

The Fifth Pair are large nerves, riſing from the annular proceſſes where the medullary proceſſes of the cerebellum join in the formation of that tuber, to enter the dura mater near the point of the petrous proceſs of the temporal bones; and then ſinking cloſe by the receptacula at the ſides of the ſella turcica, each becomes in appearance thicker, and goes out of the ſkull in three great branches.

The *firſt* branch of the *fifth* is the Ophthalmic, which runs through the foramen lacerum, to the orbit, having

having in its paſſage thither a connection with the ſixth pair. It is afterwards diſtributed to the ball of the eye with the third; to the noſe, along with the olfactory, which the branch of the fifth that paſſes through the foramen orbitarium internum joins, as was already mentioned in the deſcription of the firſt pair. This ophthalmic branch likewiſe ſupplies the parts at the internal canthus of the orbit, the glandula lacrymalis, fat, membranes, muſcles, and teguments of the eye-lids; its longeſt fartheſt extended branch paſſing through the foramen ſupperciliare of the os frontis, to be diſtributed to the forehead.

The *ſecond* branch of the *fifth* pair of nerves may be called MAXILLARIS SUPERIOR, from its ſerving principally the parts of the upper jaw. It goes out at the round hole of the ſphenoid bone, and ſends immediately one branch into the channel on the top of the antrum maxillare; the membrane of which and the upper teeth are ſupplied by it in its paſſage. As this branch is about to go out at the foramen orbitarium externum, it ſends a nerve through the ſubſtance of the os maxillare to come out at Steno's duct, to be diſtributed to the fore-part of the palate; and what remains of it eſcaping at the external orbitar hole, divides into a great many branches, that ſupply the cheek, upper lip, and noſtril. The next conſiderable branch of the ſuperior maxillary nerve, after giving branches which are reflected through the ſixth hole of the ſphenoid bone, to join the intercoſtal where it is paſſing through the ſkull with the carotid artery, and the portio dura of the ſeventh pair, as it paſſes through the os petroſum, is ſent into the noſe by the hole common to the palate and ſphenoidal bone; and the remaining part of this nerve runs in the palato-maxillaris canal, giving off branches to the temples and pterygoid muſcles, and comes at laſt into the palate to be loſt.

The *third* or MAXILLARIS INFERIOR branch of the *fifth* pair going out at the oval hole of the ſphenoid bone, ſerves the muſcles of the lower jaw, and the muſcles ſituated between the os hyoides and jaw: All the ſalivary glands, the amygdalæ, and the external ear, have branches from it: It has a large branch loſt in the tongue, and ſends another through the canal in the ſubſtance of the lower jaw to ſerve all the teeth there, and to come out at the hole in the fore-part of the jaw, to be loſt in the chin and under lip.

The SIXTH PAIR, which is the ſmalleſt except the fourth, riſes from the fore-part of the corpora pyramidalia; and each entering the dura mater ſome way behind the poſterior clinoid proceſs of the ſpenoid bone, has a long courſe below that membrane, and within the receptaculum at the ſide of the ſella turcica, where it is immerſed in the blood of the receptacle: It goes afterwards out at the foramen lacerum into the orbit, to ſerve the abductor muſcle of the eye.—A defect in this nerve may therefore be one cauſe of a ſtrabiſmus.—In the paſſage of this nerve below the dura mater, it lies very contiguous to the internal carotid artery, and to the ophthalmic branch of the fifth pair of nerves. At the place where the ſixth pair is contiguous to the carotid, a nerve either goes from each of them in an uncommon way, to wit, with the angle beyond where it riſes obtuſe, to deſcend with the artery, and to form the beginning of the intercoſtal nerve, according to the common deſcription; or, according to other authors, this nerve comes up from the great ganglion of the intercoſtal, to be joined to the ſixth here.

The SEVENTH PAIR comes out from the lateral part of the annular proceſs behind where the medullary proceſs of the cerebellum are joined to that tuber; and each being accompanied with a larger artery than moſt other nerves, enters the internal meatus auditorius, where the two large bundles of fibres, of which it appeared to conſiſt within the ſkull, ſoon ſeparate from each other; one of them entering by ſeveral ſmall holes into the veſtible, cochlea, and ſemicircular canals, is ſtretched on this inner camera of the ear in a very ſoft pulpy ſubſtance; and being never ſeen in the form of a firm cord, ſuch as the other parcel of this and moſt other nerves become, is called PORTIO MOLLIS of the auditory nerve.

The other part of this ſeventh pair paſſes through Galen's foramen cæcum, or Fallopius's aquæduct, in its crooked paſſage by the ſide of the tympanum; in which paſſage, a nerve ſent from the lingual branch of the inferior maxillary nerve, along the outſide of the tuba Euſtachiana, and croſs the cavity of the tympanum, where it has the name of chorda tympani, is commonly ſaid to be joined to it. The very acute angle which this nerve makes with the fifth, or the ſudden violent reflection it would ſuffer on the ſuppoſition of its coming from the fifth to the ſeventh, appears unuſual; whereas, if we ſuppoſe that it comes from the ſeventh to the fifth, its courſe would be more in the ordinary way, and the chorda tympani would be eſteemed a branch of the ſeventh pair going to join the fifth, the ſize of which is increaſed by this acquiſition. This ſmaller bundle of the ſeventh gives branches to the muſcles of the malleus, and to the dura mater, while it paſſes through the bony crooked canal; and at laſt comes out in a firm chord named PORTIO DURA, at the end of this canal, between the ſtyloid and maſtoid proceſſes of the temporal bone, giving immediately filaments to the little oblique muſcles of the head, and to thoſe that riſe from the ſtyloid proceſs. It then pierces through the parotid gland, and divides into a great many branches, which are diſperſed in the muſcles and teguments that cover all the ſide of the upper part of the neck, the whole face and cranium, as far back as the temples, including a conſiderable part of the external ear.

The EIGHTH PAIR of nerves riſe from the lateral baſes of the corpora olivaria in diſgregated fibres; and as they are entering the anterior internal part of the holes common to the os occipitis and temporum, each is joined by a nerve which aſcends within the dura mater from the tenth of the head, the firſt, ſecond and inferior cervical nerves: This every body knows has the name of the NERVUS ACCESSORIUS. When the two get out of the ſkull, the acceſſorius ſeparates from the eighth, and, deſcending obliquely outwards, paſſes through the ſterno-maſtoideus muſcle, to which it gives branches, and afterwards terminates in the trapezius and rhomboid muſcles of the ſcapula. In this courſe it is generally more or leſs joined by the ſecond cervical nerve.

The large EIGHTH PAIR, ſoon after its exit, gives nerves

nerves to the tongue, larynx, pharynx, and ganglion of the intercoſtal nervc, and being disjoined from the ninth and intercoſtal, to which it adheres cloſely ſome way, runs ſtreight down the neck behind the internal jugular vein, and at the external ſide of the carotid artery. As it is about to enter the thorax, a large nerve goes off from the eight of each ſide: This branch of the right-ſide turns round from the fore to the back part of the ſubclavian artery, while the branch of the left-ſide turns round the great curve of the aorta; and both of them mounting up again at the ſide of the œſophagus, to which they give branches, are loſt at laſt in the larynx. Theſe are called the RECURRENT nerves, which we are deſired to ſhun in the operation of bronchotomy, though their deep ſituation protects them ſufficiently.

The eighth pair, above, and at or near the place where the recurrent nerves go off from it, or frequently the recurrents themſelves, ſend off ſmall nerves to the pericardium, and to join with the branches of the intercoſtal that are diſtributed to the heart; but their ſize and ſituation are uncertain.

After theſe branches are ſent off, the par vagum on each ſide deſcends behind the great branch of the trachea, and gives numerous filaments to the lungs, and ſome to the heart in going to the œſophagus. The one of the left-ſide running on the fore-part of the œſophagus, communicates by ſeveral branches with the right one in its deſcent to be diſtributed to the ſtomach: The right one gets behind the œſophagus, where it ſplits and rejoins ſeveral times before it arrives at the ſtomach, to which it ſends nerves; and then being joined by one or more branches from the left trunk, they run towards the cæliac artery, there to join into the great ſemilunar ganglion formed by the two intercoſtals.

The NINTH PAIR of nerves comes from the inferior part of the corpora pyramidalia, to go out of the ſkull at their proper holes of the occipital bone. After their egreſs they adhere for ſome way firmly to the eighth and intercoſtal; and then ſending a branch, that in many ſubjects is joined with branches of the firſt and ſecond cervical nerves, to be diſtributed to the thyroid gland and muſcles on the fore-part of the trachea arteria, the ninth is loſt in the muſcles and ſubſtance of the tongue.

The TENTH PAIR riſes in ſeparate threads from the ſides of the ſpinal marrow, to go out between the os occipitis and firſt vertebra of the neck. After each of them has given branches to the great ganglion of the intercoſtal, 8th, 9th, and 1ſt cervical nerves, it is diſtributed to the ſtreight, oblique, and ſome of the extenſor muſcles of the head.

The branch reflected from the ſixth pair, joined poſſibly by ſome filaments of the opththalmic branch of the fifth, runs along with the internal carotid artery, through the crooked canal formed for it in the temporal bone, where the little nerve is very ſoft and pappy, and in ſeveral ſubjects divides and unites again, and is joined by one or more branches from the fifth particularly of its ſuperior maxillary branch, before it comes out of the ſkull. As ſoon as the nerve eſcapes out of this bony canal, it is connected a little way with the eighth and ninth; then ſeparating from theſe, after ſeeming to receive additional nerves from them, it forms a large ganglion, into which branches from the tenth of the head, and from the firſt and ſecond cervical, enter. From this ganglion the nerves come out again ſmall, to run down the neck along with the carotid artery, communicating by branches with the cervical nerves, and giving nerves to the muſcles that bend the head and neck. As the intercoſtal is about to enter the thorax, it forms another ganglion, from which nerves are ſent to the trachea and to the heart; theſe deſigned for the heart joining with the branches of the eighth, and moſt of them paſſing between the two great arteries and the auricles, to the ſubſtance of that muſcle. The intercoſtal after this conſiſting of two branches, one going behind, and the other running over the fore-part of the ſubclavian artery, forms a new ganglion where the two branches unite below that artery, and then deſcending along the ſides of the vertebræ of the thorax, receives branches from each of the dorſal nerves; which branches appearing to come out between the ribs, have given the name of intercoſtal to the whole nerve. Where the addition is made to it from the fifth dorſal nerve, a branch goes off obliquely forewards; which being joined by ſuch branches from the ſixth, ſeventh, eighth, and ninth dorſal, an anterior trunk is formed, and paſſes between the fibres of the appendix muſculoſa of the diaphragm, to form, along with the other intercoſtal and the branches of the eighth pair, a large ſemilunar ganglion ſituated between the cæliac and ſuperior meſenteric arteries; the roots of which are as it were involved in a ſort of nervous net-work of this ganglion, from which a great number of very ſmall nervous threads run out to be extended on the ſurface of all the branches of thoſe two arteries, ſo as to be eaſily ſeen when any of the arteries are ſtretched, but not to be raiſed from them by diſſection; and thus the liver, gall-bladder, duodenum, pancreas, ſpleen, jejunum, ilium, and a large ſhare of the colon, have their nerves ſent from this great ſolar ganglion or plexus.

Several fibres of this ganglion, running down upon the aorta, meet with other nerves ſent from the poſterior trunk of the intercoſtal, which continues its courſe along the ſides of the vertebra, they ſupply the glandulæ renales, kidneys, and teſtes in men, or ovaria in women; and then they form a net-work upon the inferior meſenteric artery where the nerves of the two ſides meet, and accompany the branches of this artery to the part of the colon that lies in the left ſide of the belly, and to the rectum, as far down as to the lower part of the pelvis.

The intercoſtal continuing down by the ſide of the vertebræ of the loins, is joined by nerves coming from between theſe vertebræ, and ſends nerves to the organs of generation and others in the pelvis, being even joined with thoſe that are ſent to the inferior extremities.

The SPINAL NERVES riſe generally by a number of diſgregated fibres from both the fore and back part of the medulla ſpinalis, and ſoon after form a little knot or ganglion, where they acquire ſtrong coats, and are extended into firm cords. They are diſtinguiſhed by numbers, according to the vertebræ from between which they come out; the ſuperior of the two bones forming the hole through which they paſs, being the one from which the number

number is applied to each nerve. There are generally faid to be *thirty pair* of them; feven of which come out between the vertebræ of the neck, twelve between thofe of the back, five between thofe of the loins, and fix from the falfe vertebræ.

The First Cervical pair of nerves comes out between the firft and fecond vertebræ of the neck; and having given branches to join with the tenth pair of the head, the fecond cervical and intercoftal, and to ferve the mufcles that bend the neck, it fends its largeft branches backwards to the extenfor mufcles of the head and neck; fome of which piercing through thefe mufcles, run up on the occiput to be loft in the teguments here; and many fibres of it advance fo far forward as to be connected with the fibrils of the firft branch of the fifth pair of the head, and of the portio dura of the auditory nerve.

The Second Cervical is foon joined, by fome branches, to the ninth of the head and intercoftal, and to the firft and third of the neck; then has a large branch that comes out at the exterior edge of the fterno-maftoidæus mufcle, where it joins with the acceflorius of the eighth pair; and is afterwards diftributed to the platyfma myoides, teguments of the fide of the neck and head, parotid gland, and external ear, being connected to the portio dura of the auditory nerve, and to the firft cervical. The remainder of this fecond cervical is fpent on the levator fcapulæ and the extenfors of the neck and head. Generally a large branch is here fent off to join the accefforius of the eighth pair, near the fuperior angle of the fcapula.

The Third Pair of the neck paffes out between the third and fourth cervical vertebræ; having immediately a communication with the fecond, and fending down a branch, which being joined by a branch from the fourth cervical, forms the Phrenic nerve. This defcending, enters the thorax, between the fubclavian vein and artery; and then being received into a groove, formed for it in the pericardium, it has its courfe along this capfula of the heart, till it is loft in the middle part of the diaphragm. The right phrenic has a ftreight courfe; but the left one is obliged to make a confiderable turn outwards, to go over the prominent part of the pericardium, where the point of the heart is lodged.——The middle of the diaphragm fcarce could have been fupplied by any other nerve which could have had fuch a ftreight courfe as the phrenic has.

The other branches of the third cervical nerve are diftributed to the mufcles and teguments at the lower part of the neck and top of the fhoulder.

The Fourth Cervical nerve, after fending off that branch which joins with the third to form the phrenic, and beftowing twigs on the mufcles and glands of the neck, runs to the arm-pit, where it meets with the Fifth, Sixth, and Seventh cervicals, and First Dorsal, that efcape in the interftices of the mufculi fcaleni, to come at the arm-pit, where they join, feparate, and rejoin, in a way fcarce to be rightly expreffed in words; and, after giving feveral confiderable nerves to the mufcles and teguments which cover the thorax, they divide into feveral branches, to be diftributed to all the parts of the fuperior extremity. Seven of thefe branches we fhall defcribe under particular names.

1. Scapularis runs ftreight to the cavitas femilunata of the upper cofta of the fcapula, which is a hole, in the recent fubject, by a ligament being extended from one angle of the bone to the other, giving nerves in its way to the mufcles of the fcapula. When it has paffed this hole, it fupplies the fupra-fpinatus mufcle; and then defcending at the anterior root of the fpine of the fcapula, it is loft in the other mufcles that lie on the dorfum of that bone.

2. Articularis finks downward at the axilla, to get below the neck of the head of the os humeri, and to mount again at the back-part of it; fo that it almoft furrounds the articulation, and is diftributed to the mufcles that draw the arm back, and to thofe that raife it up.

3. Cutaneus runs down the fore-part of the arm, near the fkin, to which it gives off branches; and then divides, on the infide of the fore-arm, into feveral nerves, which fupply the teguments there, and on the palm of the hand.

4. Musculo-Cutaneus, or *perforans Cafferi*, paffes through the coraco-brachialis mufcle; and, after fupplying the biceps flexor cubiti and brachiæus internus, paffes behind the tendon of the biceps, and over the cephalic vein, to be beftowed on the teguments on the outfide of the fore-arm and back of the hand.

5. Muscularis has a fpiral courfe from the axilla, under the os humeri, and backward to the external part of that bone, fupplying by the way the extenfor mufcles of the fore-arm, to which it runs between the two brachiæi mufcles, and within the fupinator radii longus.—At the upper part of the fore-arm, it fends off a branch, which accompanies the fupinator longus till it comes near the wrift, where it paffes obliquely over the radius, to be loft in the back of the hand and fingers. The principal part of this nerve pierces through the fupinator radii brevis, to ferve the mufcles that extend the hand and fingers, whofe actions are not injured when the fupinator acts.

6. Ulnaris is extended along the infide of the arm, to give nerves to the mufcles that extend the fore-arm, and to the teguments of the elbow: Towards the lower part of the arm, it flants a little back-ward, to come at the groove behind the internal condyle of the os humeri, through which it runs to the ulna: In its courfe along this bone, it ferves the neighbouring mufcles and teguments; and as it comes near the wrift, it detaches a branch obliquely over the ulna to the back of the hand, to be loft in the convex part of feveral fingers. The larger part of the nerve goes ftreight forward to the internal fide of the os pififorme of the wrift; where it fends off a branch which finks under the large tendons in the palm, to go crofs to the other fide of the wrift, ferving the mufculi lumbricales and interoffei, and at laft terminating in the fhort mufcles of the thumb and fore-finger. What remains of the ulnar nerve, after fupplying the fhort mufcles of the little finger, divides into three branches; whereof two are extended along the fides of the fheath of the tendons of the flexors of the little finger, to furnifh the concave fide of that finger; and the

third branch is difpofed in the fame way upon the fide of the ring-finger next to the little finger.

When we lean or prefs on the internal condyle of the os humeri, the numbnefs and prickling we frequently feel, point out the courfe of this nerve.

7. Radialis accompanies the humeral artery to the bending of the elbow, ferving the flexors of the cubit in its way; then paffing through the pronator radii teres mufcle, it gives nerves to the mufcles on the fore-part of the fore-arm, and continues its courfe near to the radius, beftowing branches on the circumjacent mufcles. Near the wrift, it fometimes gives off a nerve, which is diftributed to the back of the hand, and the convex part of the thumb, and feveral of the fingers, inftead of the branch of the mufcular. The larger part of this nerve, paffing behind the annular ligament of the wrift, gives nerves to the fhort mufcles of the thumb; and afterwards fends a branch along each fide of the fheath of the tendons of the flexors of the thumb, fore-finger, mid-finger, and one branch to the fide of the ring-finger, next to the middle one, to be loft on the concave fide of thofe fingers.

Though the radial nerve paffes through the pronator mufcle, and the mufcular nerve feems to be ftill more unfavourably placed within the fupinator brevis; yet the action of thefe mufcles do not feem to have any effect in hindering the influence of thefe nerves, for the fingers or hand can be bended while pronation is performing vigoroufly, and they can be extended while fupination is exercifed.

The manner of the going off of thefe nerves of the fingers, both from the ulnar and radial, is, that a fingle branch is fent from the trunk to the fide of the thumb and little finger, fartheft from the other fingers; and all the reft are fupplied by a trunk of a nerve, which fplits into two fome way before it comes as far as the end of the metacarpus, to run along the fides of different fingers that are neareft to each other.

It might have been obferved, that, in defcribing the pofterior branches of the ulnar and mufcular nerve, we did not mention the particular fingers, to the convex part of which they are diftributed. The reafon of this omiffion is, the uncertainty of their diftribution; for though fometimes thefe pofterior branches go to the fame fingers, to the concave part of which the anterior branches of the ulnar and radial are fent, yet frequently they are diftributed otherwife.

The fituation of thefe brachial nerves in the axilla, may let us fee how a weaknefs and atrophy may be brought on the arms by a long continued preffure of crutches, or fuch other hard fubftances on this part; and the courfe of them from the neck to the arm, may teach us, how much better effects veficatories, or ftimulating nervous medicines, would have, when applied to the fkin, covering the tranfverfe proceffes of the vertebræ of the neck, or at the axilla, than when they are put between the fhoulders, or upon the fpinal proceffes, in convulfions or palfies of the fuperior extremities, where a ftimulus is required.

The Twelve Dorsal nerves of each fide, as foon as they efcape from between the vertebræ, fend a branch forward to join the intercoftal, by which a communication is made among them all; and they foon likewife give branches backwards to the mufcles that raife the trunk of the body, their principal trunk being extended outwards, to come at the furrow in the lower edge of each rib, in which they run toward the anterior part of the thorax, between the internal and external intercoftal mufcles, giving off branches in their courfe to the mufcles and teguments of the thorax.

The First dorfal, as was already obferved, is particular in this, that it contributes to form the brachial nerves; and that the two branches of the intercoftal, which come down to the thorax, form a confiderable ganglion with it.

The Six lower dorfal nerves give branches to the diaphragm and abdominal mufcles.

The Twelfth joins with the firft lumbar, and beftows nerves on the mufculus quadratus lumborum and iliacus internus.

As the intercoftal is larger in the thorax than any where elfe, and feems to diminifh gradually as it afcends and defcends, there is caufe to fufpect that this is the trunk from which the fuperior and inferior pairs are fent as branches.

The Five Lumbar nerves on each fide communicate with the intercoftal and with each other, and give branches backwards to the loins.

The First communicates with the laft dorfal, fends branches to the abdominal mufcles, to the pfoas and iliacus, and to the teguments and mufcles on the fore-part of the thigh; while its principal branch joins with the other nerves, to form the crural nerve.

The Second Lumbar nerve paffes through the pfoas mufcle, and is diftributed nearly in the fame way as the former: as is alfo the Third.

Branches of the *fecond*, *third*, and *fourth*, make up one trunk, which runs along the fore-part of the pelvis; and, paffing in the notch at the fore-part of the great hole common to the os pubis and ifchium, is fpent on the adductor mufcles, and on the teguments on the infide of the thigh. This nerve is called the Obturator, or Posterior Crural Nerve.

By united branches from the *firft*, *fecond*, *third*, and *fourth* lumbar nerves, a nerve is formed that runs along the pfoas mufcle, to efcape with the external iliac veffels out of the abdomen, below the tendinous arcade of the external oblique mufcle. This nerve, which is named the Anterior Crural, is diftributed principally to the mufcles and teguments on the fore-part of the thigh. A branch, however, of this nerve runs down the infide of the leg to the upper part of the foot, keeping near to the vena faphæna; in opening of which with a lancet at the ankle, the nerve is fometimes hurt, and occafions fharp pain at the time of the operation, and numbnefs afterwards.

The Sixth Pair of the falfe Vertebræ confift each of fmall pofterior branches, fent to the hips, and of large anterior branches.

The *firft*, *fecond*, and *third*, after coming through the three upper holes in the fore-part of the os facrum, join together with the fourth and fifth of the loins, to

form

form the largeſt nerve of the body, which is well known by the name of SCIATIC or ISCHIATIC nerve: This, after ſending large nerves to the different parts of the pelvis, and to the external parts of generation, and the podex, as alſo to the muſcles of the hips, paſſes behind the great tuber of the os iſchium, and then over the quadrigemini muſcles, to run down near to the bone of the thigh at its back-part, giving off nerves to the neighbouring muſcles and teguments. Some way above the ham, where it has the name of the *poplitæus* nerve, it ſends off a large branch that paſſes over the fibula, and ſinking in among the muſcles on the anterior external part of the leg, runs down to the foot, to be loſt in the upper part of the larger toes, ſupplying the neighbouring muſcles and teguments every where in its paſſage. The larger branch of the ſciatic, after giving branches to the muſcles and teguments about the ham and knee, and ſending a large cutaneous nerve down the calf of the leg, to be loſt at laſt on the outſide of the foot and upper part of the leſſer toes, ſinks below the gemellus muſcle, and diſtributes nerves to the muſcles on the back of the leg; among which it continues its courſe, till paſſing behind the internal malleolus, and in the internal hollow of the os calcis, it divides into the two plantar nerves: The internal of which is diſtributed to the toes, in the ſame manner that the radial nerve of the hand ſerves the concave ſide of the thumb and fingers; and the external plantar is divided and diſtributed to the ſole of the foot and toes, nearly as the ulnar nerve is in the palm of the hand, and in the concave part of the fingers.

Several branches of theſe nerves, that ſerve the inferior extremities, pierce through muſcles.

The FOURTH, which, with the two following, is much ſmaller than the three ſuperior, ſoon is loſt in the veſica urinaria and inteſtinum rectum.

The FIFTH comes forward between the extremity of the os ſacrum and coccygis, to be diſtributed principally to the levatores ani.

The SIXTH, which ſome think to be only a production of the dura mater, advances forward below the broad ſhoulders of the firſt bone of the os coccygis, and is loſt in the ſphincter ani and teguments covering it.

The ſize of the nerves of the inferior extremities ſeems larger proportionally than in the ſuperior extremities; the inferior extremities having the weight of the whole body to ſuſtain, and that frequently at a great diſadvantage.——What the effect is of the nerves here being injured, we ſee daily, when people happen, by ſitting wrong, to compreſs the ſciatic nerve, they are incapable for ſome time after to ſupport themſelves on the affected extremity; and this is ſtill more remarkable in the ſciatic or hip-gout, in which the member is not only weakened, but gradually ſhrivels and waſtes.

USES *of the Nerves*.

MANY experiments concur in proving, that the nerves are the inſtruments of ſenſation. As to the mode of their operation, ſeveral different theories have been given. Some ſuppoſe, that they are elaſtic cords, reſembling fiddle-ſtrings; and that they convey ſenſations to the brain by a kind of vibratory motion. Others have ſuppoſed them to be tubular, and to contain a fluid called *animal ſpirits*; and that ſenſation is produced by the motions and counter-motions of this fluid. Many uſeleſs volumes have been wrote upon each of theſe hypotheſes.—Another and more recent theory ſuppoſes, that the nerves are not tubular, but that they are pervaded by a ſubtile elaſtic fluid called *Æther*; and that ſenſation, *&c.* are occaſioned by the oſcillations of that fluid. A few detached and ill-digeſted ſcraps of this theory have already appeared in ſome temporary productions, the principal of which has been ſufficiently animadverted upon under the word ÆTHER.

EXPLANATION OF PLATE XVIII.

FIG. 1. Repreſents the inferior part of the brain;—the anterior part of the whole ſpine, including the medulla ſpinalis;—with the origin and large portions of all the NERVES.

A A, The anterior lobes of the cerebrum. B B, The lateral lobes of the cerebrum. C C, The two lobes of the cerebellum. D, Tuber annulare. E, The paſſage from the third ventricle to the infundibulum. F, The medulla oblongata, which ſends off the medulla ſpinalis through the ſpine. G G, That part of the os occipitis which is placed above (H H), the the tranſverſe proceſſes of the firſt cervical vertebra. I I, &c. The ſeven cervical vertebræ, with their intermediate cartilages. K K, &c. The twelve dorſal vertebræ, with their intermediate cartilages. L L, &c. The five lumbar vertebræ, with their intermediate cartilages. M, The os ſacrum. N, The os coccygis.

NERVES.—1 1, The firſt pair of nerves, named *olfactory*, which go to the noſe. 2 2, The ſecond pair, named *optic*, which goes to form the tunica retina of the eye. 3 3, The third pair, named *motor oculi*; it ſupplies moſt of the muſcles of the eye-ball. 4 4, The fourth pair, named *pathetic*,—which is wholly ſpent upon the muſculus trochlearis of the eye. 5 5, The fifth pair divides into three branches.—The firſt, named *ophthalmic*, goes to the orbit, ſupplies the lachrymal gland, ſends branches out to the forehead and noſe.—The ſecond, named *ſuperior maxillary*, ſupplies the teeth of the upper jaw, and ſome of the muſcles of the lips.—The third, named *inferior maxillary*, is ſpent upon the muſcles and teeth of the lower jaw, tongue, and muſcles of the lips. 6 6, The ſixth pair, which, after ſending off the beginning of the intercoſtal or great ſympathetic, is ſpent upon the abductor oculi. 7 7, The ſeventh pair, named *auditory*, divides into two branches.—The largeſt, named *portio mollis*, is ſpent upon the internal ear.—The ſmalleſt, *portio dura*, joins to the fifth pair within the internal ear by a reflected branch from the ſecond of the fifth, and within the tympanum, by a branch from the third of the fifth, named *chorda tympani*.—Vid. fig. 3. near B. 8 8, &c. The eighth pair, named *par vagum*,— which accompanies the intercoſtal, and is ſpent upon the tongue, larynx, pharynx,

rynx, lungs, and abdominal viſcera. 9 9, The ninth pair, which are ſpent upon the tongue. 10 10, &c. The intercoſtal, or great ſympathetic, which is ſeen from the ſixth pair to the bottom of the pelvis on each ſide of the ſpine, and joining with all the nerves of the ſpine;—in its progreſs ſupplying the heart, and, with the par vagum, the contents of the abdomen and pelvis. 11 11, The acceſſorius, which is ſpent upon the ſterno-cleido maſtoidæus and trapezius muſcles. 12 12, The firſt cervical nerves;—13 13, The ſecond cervical nerves;—both ſpent upon the muſcles that lie on the neck, and teguments of the neck and head. 14 14, The third cervical nerves, which, after ſending off (15 15, &c.) the phrenic nerves to the diaphragm,—ſupply the muſcles and teguments that lie on the ſide of the neck and top of the ſhoulder. 16 16, The brachial plexus, formed by the fourth, fifth, ſixth, ſeventh cervicals, and firſt dorſal nerves,—which ſupply the muſcles and teguments of the ſuperior extremity. 17 17, The twelve dorſal, or proper intercoſtal nerves, which are ſpent upon the intercoſtal muſcles and ſome of the large muſcles which lie upon the thorax. 18 18, The five lumbar pairs of nerves, which ſupply the lumbar and abdominal muſcles, and ſome of the teguments and muſcles of the inferior extremity. 19 19, The ſacro-ſciatic, or poſterior crural nerve, formed by the two inferior lumbar, and three ſuperior of the os ſacrum.—This large nerve ſupplies the greateſt part of the muſcles and teguments of the inferior extremity. 20, The ſtomachic plexus, formed by the eighth pair. 21 21, Branches of the ſolar or cæliac plexus, formed by the eighth pair and intercoſtals, which ſupply the ſtomach and chylopoetic viſcera. 22 22, Branches of the ſuperior and inferior meſenteric plexuſes, formed by the eighth pair and intercoſtals, which ſupply the chylopoetic viſcera, with part of the organs of urine and generation. 23 23, Nerves which accompany the ſpermatic cord. 24 24, The hypogaſtric plexus, which ſupplies the organs of urine and generation within the pelvis.

Fig. 2, 3, 4, 5. Shews different views of the inferior part of the brain, cut perpendicularly through the middle,—with the origin and large portions of all the nerves which paſs out through the bones of the cranium,—and the three firſt cervicals.

A, The anterior lobe. B, The lateral lobe of the cerebrum. C, One of the lobes of the cerebellum. D, Tuber annulare. E, Corpus pyramidale, in the middle of the medulla oblongata. F, The corpus olivare, in the ſide of the medulla oblongata. G, The medulla-oblongata. H, The medulla ſpinalis.

Nerves.—1 2 3 4 5 6 7 8 & 9, Pairs of nerves. 10 10, Nervus acceſſorius, which comes from—11 12 & 13, the three firſt cervical nerves.

PART VI.

Of ſuch Parts of the Body as could not properly be deſcribed under any of the former general Diviſions.

Sect. I. *Of the common Integuments.*

THE SKIN.

THE ſkin is a ſubſtance of very large extent, made up of ſeveral kinds of tendinous, membranous, vaſcular, and nervous fibres, the intertexture of which is ſo much the more wonderful, as it is difficult to unfold; for their directions are as various as thoſe of the ſtuff of which an hat conſiſts.

This texture is what we commonly call leather, and it makes, as it were, the body of the ſkin. It is not eaſily torn, may be elongated in all directions, and afterwards recovers itſelf, as we ſee in fat perſons, in women with child, and in ſwellings; and it is thicker and more compact in ſome places than in others.

Its thickneſs and compactneſs are not, however, always proportionable; for on the poſterior parts of the body, it is thicker and more lax than on the fore-parts; and on the palms of the hands, and ſoles of the feet, it is both very thick and very ſolid.

The outer ſurface of this ſubſtance is furniſhed with ſmall eminences, which anatomiſts have thought fit to call *papillæ*, in which the capillary filaments of the cutaneous nerves terminate by ſmall radiated pencils.

Theſe papillæ differ very much in figure and diſpoſition in the different parts of the body, and they may be diſtinguiſhed into ſeveral kinds.

The greateſt part of them is flat, of different breadths, and ſeparated by ſulci, which form a kind of irregular lozenges. The pyramidal figure aſcribed to them, is not natural, and appears only when they are contracted by cold or by diſeaſes.

The papillæ of the palm of the hand, of the ſole of the foot, and of the fingers and toes, are higher than on the other parts of the body; but they are likewiſe ſmaller, cloſely united together, and placed as it were endwiſe, with reſpect to each other, in particular rows, which repreſent on the ſkin all kinds of lines, ſtraight, crooked, waving, ſpiral, *&c.* Theſe ſeveral lines are often diſtinctly viſible in thoſe parts of the palm of the hand which are next the firſt phalanges of the fingers.

The red part of the lips is made up of papillæ, repreſenting very fine hairs or villi, cloſely united together.

There is another particular kind under the nails; the papillæ being there more pointed, or in a manner conical, and turned obliquely towards the ends of the fingers.

Thoſe

Thofe which are found in the hairy fcalp, fcrotum, *&c.* are ftill of other kinds.

The papillæ of the firft and fecond kinds appear to be furrounded at their bafes by a foft mucilaginous and pretty vifcid fubftance, which fills the interftices between them, and reprefents a kind of net-work or fieve, the mafhes or holes of which furround each papilla. This fubftance is commonly called *corpus reticulare*, or *mucofum*.

This vafcular texture is of various forms and figures in the different parts of the body.

The inner furface of the fkin is covered by very fmall tubercles, commonly called *cutaneous glands*, or *glandulæ miliares*.

These tubercles are partly fixed in fmall foffulæ, in the fubftance of the fkin, which anfwer to the fame number of fmall cavities in the corpus adipofum. Their excretory ducts open on the outer furface of the fkin, fometimes in the papillæ, and fometimes on one fide of them.

The greateft part of them furnifhes fweat, and others a fatty oily matter of different thickneffes, as in the hairy fcalp, in the back, behind the ears, and at the lower part of the nofe, where this matter may be fqueezed out, in form of fmall worms.

Befides thefe corpufcles, there are other fmall folid bodies, almoft of an oval figure, contained in the fubftance of the fkin. Thefe are the roots or bulbs from whence the hairs arife, and fome of them are fituated within the inner furface of the fkin.

The fkin has feveral confiderable openings, fome of which have particular names; fuch as the fiffure of the palpebræ, the nares, the mouth, the external foramen of the ears, the anus, and openings of the parts of generation.

Befides thefe, it is perforated by an infinite number of fmall holes, called *pores*, which are of two kinds. Some are more or lefs perceivable to the naked eye; fuch as the orifices of the milky ducts of the mammæ, the orifices of the excretory canals of the cutaneous glands, and the paffages of the hairs.

The other pores are imperceptible to the naked eye, but vifible through a microfcope; and their exiftence is likewife proved by the cutaneous tranfpiration, and by the effects of topical applications; and from thefe two phænomena, they have been divided into arterial and venal pores.

THE CUTICULA, OR EPIDERMIS.

The outfide of the fkin is covered by a thin tranfparent web, clofely joined to it, which is called *epidermis*, *cuticula*, or the *fcarf-fkin*.

The fubftance of the cuticula appears to be very uniform on the fide next the fkin, and to be compofed on the other fide of a great number of very fine fmall fquamous laminæ, without any appearance of a fibrous or vafcular texture, except fome fmall filaments, by which it is connected to the papillæ.

This fubftance is very folid and compact, but yet capable of being extended and thickened, as we fee by fteeping it in water, and by the blifters raifed on the fkin by veficatories. It yields very much in fwellings; but not fo much as the fkin, without breaking or cracking.

Hard and reiterated frictions loofen it infenfibly, and prefently afterward, a new ftratum arifes, which thrufts the firft outward, and may itfelf be loofened and thruft outward by a third ftratum, and fo on.

The epidermis adheres very clofely to the cutaneous papillæ, from which it may be feparated by boiling; or by fteeping, for a long time, in cold water.

It adheres ftill clofer to the corpus reticulare, which is eafily raifed along with it; and they feem to be true portions or continuations of each other.

The epidermis covers the fkin through its whole extent, except at the places where the nails lie. It is marked with the fame furrows and lozenges as the fkin, and has the fame openings and pores; and though it may be faid to pafs the bounds of the fkin, where it is continued inward, through the great openings, yet at thefe places it lofes the name of epidermis.

When we examine narrowly the fmall pores or holes, through which the fweat paffes, the epidermis feems to enter thefe, in order to compleat the excretory tubes of the cutaneous glands. The foffulæ of the hairs have likewife the fame productions of the epidermis, and it feems to give a fort of coat or bark to the hairs themfelves. Laftly, the almoft imperceptible ducts of the cutaneous pores are lined by it.

USES OF THE SKIN.

It is chiefly and properly the filamentary fubftance, called the body of the fkin, which is the univerfal integument of the body, and the bafis of all the other cutaneous parts; each of which has its particular ufes.

The fkin is able to refift external injuries to a certain degree, and fuch impreffions, frictions, ftrokes, *&c.* to which the human body is often liable, as would hurt, wound, and diforder the parts of which it is compofed, if they were not defended by the fkin.

The papillæ are the organ of feeling, and contribute to an univerfal evacuation, called infenfible tranfpiration. They likewife ferve to tranfmit from without, inwards, the fubtle particles or impreffions of fome things applied to the fkin. The firft of thefe three ufes depends on the extremities of the nerves, the fecond on the arterial productions, and the third on the productions of the veins.

The cutaneous glands fecrete an oily humour of different confiftences, and they are likewife the origin of fweat.

The epidermis ferves to keep the pencils or nervous filaments of the papillæ in an even fituation, and without confufion; and it likewife moderates the impreffions of external objects.

Another ufe of the epidermis is to regulate the cutaneous evacuations already mentioned, the moft confiderable of which is infenfible tranfpiration.

THE MEMBRANA ADIPOSA, AND FAT.

The fecond univerfal integument of the human body, is

is the membrana adipofa, or corpus adipofum. This is not, however, a fingle membrane, but a congeries of a great number of membranous laminæ, joined irregularly to each other at different diftances, fo as to form numerous interftices of different capacities, which communicate with each other. Thefe interftices have been named *cellulæ*, and the fubftance made up of them, the *cellulous fubftance*.

The thicknefs of the membrana adipofa is not the fame all over the body, and depends on the number of laminæ of which it is made up. It adheres very clofely to the fkin, runs in between the mufcles in general, and between their feveral fibres in particular, and communicates with the membrane which lines the infide of the thorax and abdomen.

The ftructure is demonftrated every day by butchers, in blowing up their meat, when newly killed; in doing which, they not only fwell the membrana adipofa, but the air infinuates itfelf likewife in the interftices of the mufcles, and penetrates even to the vifcera, producing a kind of artificial emphyfema.

Thefe cellular interftices are fo many little bags or fatchels, filled with an unctuous or oily juice, more or lefs liquid, which is called *fat*.

This fubftance increafes in quantity in the body, by reft and good living; and on the contrary, diminifhes by hard labour and a fpare diet.

The proportional differences in the thicknefs of this membrana adipofa, are determined, and may be obferved to be regular in fome parts of the body, where either beauty or ufe required it.

Thus we find it in great quantities, where the interftices of the mufcles would otherwife have left difagreeable hollow or void places; but being filled, and as it were padded with fat, the fkin is raifed, and an agreeable form given to the part.

In fome parts of the body the fat ferves for a cufhion, pillow, or mattrefs; as on the buttocks, where the laminæ and cells are very numerous.

The fat is likewife of great ufe to the mufcles, in preferving the flexibility neceffary for their actions, and in preventing or leffening their mutual frictions.

THE NAILS.

The fubftance of the nails is like that of horn, and they are compofed of feveral planes of longitudinal fibres foddered together. Thefe ftrata end at the extremity of each finger, and are all nearly of an equal thicknefs, but of different lengths.

The external plane or ftratum is the longeft, and the reft decreafe gradually, the innermoft being the fhorteft; fo that the nail increafes in thicknefs from its union with the epidermis, where it is thinneft, to the end of the finger, where it is thickeft.

The graduated extremities or roots of all the fibres of which thefe planes confift, are hollowed for the reception of the fame number of very fmall oblique papillæ, which are continuations of the true fkin, which having reached to the root of the nail, forms a femilunar fold, in which that root is lodged.

After this femilunar fold, the fkin is continued on the whole inner furface of the nail. The fold of the fkin is accompanied by the epidermis, to the root of the nail exteriorly, to which it adheres very clofely.

Three parts are generally diftinguifhed in the nail, the root, body, and extremity. The root is white and in form of a crefcent; and the greateft part of it is hid under the femilunar fold already mentioned.

The crefcent and the fold lie in contrary directions to each other. The body of the nail is naturally arched, tranfparent, and appears of the colour of the cutaneous papillæ which lie under it.

The principal ufe of the nails is to ftrengthen the ends of the fingers and toes, and to hinder them from being inverted towards the convex fide of the hand or foot, when we handle or prefs upon any thing hard.

THE HAIRS.

The hairs belong as much to the integuments as the nails. They are a kind of reeds or rufhes, the roots or bulbs of which lie toward that fide of the fkin which is next the membrana adipofa. The trunk or beginning of the ftem perforates the fkin, and the reft of the ftem advances beyond the outer furface of the fkin, to a certain diftance, which is very various in the different parts of the body.

When the different hairs are examined by a microfcope, we find the roots more or lefs oval, the largeft extremity being either turned toward, or fixed in the corpus adipofum.

This oval root is covered by a whitifh ftrong membrane, in fome meafure elaftic; and it is connected either to the fkin, to the corpus adipofum, or to both, by a great number of very fine veffels and nervous filaments.

Within the root, we obferve a kind of glue, fome very fine filaments of which advance toward the fmall extremity, where they unite and form the ftem, which paffes through this fmall extremity to the fkin. As the ftem paffes through the root, the outer membrane is elongated in form of a tube, which clofely invefts the ftem, and is entirely united to it.

The ftem having reached the furface of the fkin, pierces the bottom of a fmall foffula between the papillæ, or fometimes a particular papilla, and there it meets the epidermis, which feems to be inverted round it, and to unite with it entirely. A fort of unctuous matter tranfudes through the fides of the foffula, which is beftowed on the ftem, and accompanies it, more or lefs, as it runs out from the fkin, in form of an hair.

Sect. II. *Of the* Abdomen.

The Abdomen begins immediately under the thorax, and terminates at the bottom of the pelvis of the offa innominata. Its circumference, or outer furface, is divided into regions, of which there are three anterior, *viz.* the epigaftric or fuperior region, the umbilical or middle region, and the hypogaftric or lower region. There is but one pofterior region, named regio lumbaris.

The

The epigaſtric region begins immediately under the appendix enſiformis, at a ſmall ſuperficial depreſſion, called the pit of the ſtomach, and ends above the navel at a tranſverſe line, ſuppoſed to be drawn between the laſt falſe ribs on each ſide.

This region is ſubdivided into three parts; one middle, named epigaſtrium; and two lateral, termed hypochondria. The epigaſtrium takes in all that ſpace which lies between the falſe ribs of both ſides, and the hypochondria are the places covered by the falſe ribs.

The umbilical region begins above the navel, at the tranſverſe line already mentioned, and ends below the navel at another tranſverſe line, ſuppoſed to be drawn parallel to the former, between the two criſtæ of the os ilium.

This region is likewiſe divided into three parts; one middle, which is properly the regio umbilicalis; and two lateral, called ilia, or the flanks; and they comprehend the ſpace between the falſe ribs and upper part of the os ilium on each ſide.

The hypogaſtric region is extended downward from the inferior limit of the umbilical region, and is divided into three parts; one middle, called pubis; and two lateral, called inguina, or the groins.

The lumbar region is the poſterior part of the abdomen, and comprehends all that ſpace which reaches from the loweſt ribs on each ſide, and the laſt vertebra of the back, to the os ſacrum and neighbourings parts of the oſſa ilium. The lateral parts of this region are termed the loins, but the middle part has no proper name in men.

Laſtly, the bottom of the abdomen, which anſwers to the pelvis of the ſkeleton, is terminated anteriorly by the pudenda or parts of generation, and poſteriorly by the clunes and anus. The buttocks are ſeparated by a foſſa, which leads to the anus; and each buttock is terminated downward by a large fold, which diſtinguiſhes it from the reſt of the thigh.

The ſpace between the anus and the parts of generation, is called perinæum, and is divided into two equal lateral parts by a very diſtinct line, which is longer in males than in females.

The cavity of the abdomen, formed by the parts already mentioned, (all which are covered by the ſkin and membrana adipoſa) is lined on the inſide by a particular membrane, called peritonæum. It is ſeparated from the cavity of the thorax by the diaphragm, and terminated below by the muſculi levatores ani.

This cavity contains the ſtomach, and the inteſtines. It contains likewiſe the meſentery, meſocolon, omentum, liver, gall bladder, ſpleen, pancreas, glands of the meſentery, vaſa lactea, receptaculum chyli, kidneys, renal glands, ureters, bladder, and the internal parts of generation in both ſexes.

The whole fore-part of the abdomen forms an oblong convexity, like an oval vault, more or leſs prominent in the natural ſtate, in proportion to the quantity of fat upon it, and of food contained in it, or to the different degrees of pregnancy in women. The hypogaſtric and umbilical regions are more ſubject to theſe varieties, than the epigaſtric region.

The appendix enſiformis of the ſternum, the cartilaginous portions of the laſt pair of true ribs, thoſe of the firſt four pairs of falſe ribs, all the fifth pair, the five lumbar vertebræ, the oſſa innominata, the os ſacrum, and os coccygis, form the bony ſides of the cavity of the abdomen.

The diaphragm, the muſcles called particularly muſculi abdominis, the quadrati lumborum, pſoai, iliaci, the muſcles of the coccyx, and of the inteſtinum rectum, form the chief part of the circumference of this cavity,

The cavity of the abdomen is of an irregularly oval figure, but ſtill ſymmetrical. On the foreſide it is uniformly arched or oval, and its greateſt capacity is even with the navel, and neareſt part of the hypogaſtrium. On the upper ſide it is bounded by a portion of a vault, very much inclined. On the backſide, it is in a manner divided into two cavities by the jutting out of the vertebræ of the loins. On the lower ſide, it contracts gradually all the way to the little edge of the pelvis, and from thence expands again a little as far as the os coccygis and tubercles of the iſchium, terminating in the void ſpace between theſe three parts.

PERITONÆUM.

Having carefully removed the muſcles of the abdomen, the firſt thing we diſcover is the peritonæum, a membranous covering, which adheres immediately to the inner ſurface of the muſculi tranſverſi, and of all the other parts of this cavity; and involves and inveſts all the viſcera contained therein, as in a kind of bag.

The peritonæum in general is a membrane of a pretty cloſe texture, and yet very limber, and capable of a very great extenſion; after which it can recover itſelf, and be contracted to its ordinary ſize; as we ſee in pregnancy, dropſies, corpulency, and repletion.

It ſeems to be made up at leaſt of two portions, one internal, the other external; which have been looked upon by many anatomiſts as a duplicature of two diſtinct membranous laminæ. But, properly ſpeaking, the internal portion alone deſerves the name of a membranous lamina, as being the main body of the peritonæum. The external portion is no more than a kind of fibrous or follicular apophyſis of the internal; and may properly enough be termed the cellular ſubſtance of the peritonæum.

The true membranous lamina, commonly called the internal lamina, is very ſmooth, and poliſhed on that ſide which is turned to the cavity and viſcera of the abdomen, and continually moiſtened by a ſerous fluid diſcharged through almoſt imperceptible pores.

The cellular ſubſtance, or external portion of the peritonæum, adheres very cloſely to the parts which form the inſides of the cavity of the abdomen.

The cellular ſubſtance has ſeveral elongations, which have been called productions of the peritonæum. Two of theſe productions accompany and inveſt the ſpermatic ropes in males, and the vaſcular ropes, commonly called the round ligaments, in women. There are other two, which paſs under the ligamentum Falloppii, with the

crural veſſels, which they involve, and are gradually loſt in their courſe downward.

To theſe four productions of the cellular ſubſtance of the peritonæum, we may add a fifth, which is ſpread on the neck of the bladder, and perhaps a ſixth, which accompanies the inteſtinum rectum. All theſe elongations paſs out of the cavity of the abdomen, and may be termed external, to diſtinguiſh them from others that remain in the abdomen, and are called internal, of which hereafter.

The great blood-veſſels, that is, the aorta and vena cava, are likewiſe involved in this cellular ſubſtance of the peritonæum. In a word, it involves immediately and ſeparately all the parts and organs which are commonly ſaid to lie in the duplicature of the peritonæum.

It has, nevertheleſs, productions of its own, but they are very different from thoſe of the cellular ſubſtance; for they run from without, inward, that is, they advance from the convex ſide of the great bag of the peritonæum, into the cavity of that bag, ſome more, ſome leſs, and alſo in different manners; as if the ſides of a large ball or bladder were thruſt inward into the cavity of the ball or bladder.

Of theſe internal elongations or intropreſſions of the true lamina of the peritonæum, ſome are ſimply folded, like a duplicature; ſome are expanded like inverted bags or ſacculi to contain ſome viſcus; ſome begin by a ſimple duplicature, and are afterwards expanded into a cavity, which contains ſome organ; ſome are alternately extended in the form of ſimple duplicatures, and of cavities; and laſtly, ſome form only a ſmall eminence on the inner ſurface of the great cavity of the peritonæum.

The chief uſes of the peritonæum are, to line the cavity of the abdomen, to inveſt the viſcera contained in that cavity as in a common bag, to ſupply them with particular coats, to form productions, ligaments, connexions, folds, vaginæ, *&c.*

The fine fluid which tranſudes through the whole internal ſurface of the peritonæum, prevents the inconveniences which might ariſe from the continual frictions and motions to which the viſcera of the abdomen are expoſed either naturally or by external impulſes.

VENTRICULUS, OR STOMACH.

The ſtomach is a great bag or reſervoir, ſituated partly in the left hypochondrium, and partly in the epigaſtrium.

The figure of the ſtomach is like that of a bag-pipe, oblong, incurvated, large and capacious at one end, and ſmall and contracted at the other.

The curvature of the ſtomach gives us occaſion to diſtinguiſh two arches in it; one large, which runs along the greateſt convexity; and one ſmall, directly oppoſite to the former. The ſides of the ſtomach, are the two lateral portions which lie between the two arches.

The ſtomach has two extremities, one large, and one ſmall like a crooked funnel. It has two openings, called the orifices of the ſtomach, one between the great extremity and the ſmall curvature, the other at the end of the ſmall or contracted extremity. The firſt opening is a continuation of the œſophagus; the other joins the inteſtinal canal, and is called pylorus.

The great extremity of the ſtomach is in the left hypochondrium, and for the moſt part immediately under the diaphragm.

The ſmall extremity of the ſtomach does not reach to the right hypochondrium. It bends obliquely backward toward the upper orifice, ſo that the pylorus lies about two fingers breadth from the body of the vertebræ immediately under the ſmall portion of the liver, and conſequently lower down, and more forward than the other orifice by almoſt the ſame diſtance.

According to this natural ſituation, the ſtomach, eſpecially when full, lies ſo as that the great curvature is turned more upward than downward, and the ſmall curvature more backward than upward.

One of the lateral convex ſides is turned upward, the other downward; and not forward and backward, as they appear in dead bodies, where the inteſtines do not ſupport them in their natural ſituation.

The ſtomach is compoſed of ſeveral parts, the chief of which are the different ſtrata which form its ſubſtance, to which anatomiſts give the name of tunicæ or coats. Theſe coats are commonly reckoned to be four in number, the outer or common, the fleſhy or muſcular, the nervous or aponeurotic, and the villous or inner coat; and they are afterwards ſubdivided ſeveral ways.

The firſt or outermoſt coat is ſimply membranous, being one of the internal productions of the peritonæum.

The ſecond or muſcular coat is made up of ſeveral planes of fibres, which may all be reduced to two, one external, the other internal. The external coat is longitudinal, though in different reſpects, following nearly the direction of the curvatures and convexities of the ſtomach; and the internal plane is tranſverſely circular.

Between the outer and inner planes, round the ſuperiour orifice, there are two diſtinct planes, about the breadth of a finger, and very oblique, which ſurround this orifice in oppoſite directions, and interſect each other where they meet on the two lateral ſides.

Along the middle of each lateral ſide of the ſmall extremity, there runs a tendinous or ligamentary flat portion, above a quarter of an inch in breadth, which terminates in the pylorus. Theſe two portions lie between the common and muſcular coats, and adhere very ſtrongly to the firſt.

Between the ſame two coats, there is a cellular ſubſtance which adheres very cloſely to the external coat, and inſinuates itſelf between the fleſhy fibres of the ſecond, all the way to the third.

The third coat, called commonly tunica nervoſa, ſuſtains, on its convex ſide, a very large reticular diſtribution of capillary veſſels and nerves. On the concave ſide, it ſeems to be of a very looſe texture, and as it were ſpungy or filamentary, containing a great number of ſmall glandular bodies, eſpecially near the ſmall curvature and ſmall extremity of the ſtomach.

The fourth coat of the ſtomach is termed villoſa, becauſe, when it ſwims in clear water, ſome have imagined they ſaw ſomething in it like the pile of velvet.

Theſe two coats are of a larger extent than the two former,

former, and they join in forming large rugæ on the concave surface of the ſtomach, the greateſt part of which are tranſverſe, though irregular and waving.

In the interſtices of theſe rugæ, there is often found a ſort of ſlimy mucus, with which the whole cavity of the ſtomach ſeems likewiſe to be moiſtened. This mucus is much more fluid in living bodies, and is ſupplied by the glands of the ſtomach. It is termed ſuccus gaſtricus or ſtomachicus.

On the inner ſurface of the ſmall extremity of the ſtomach, at the place where it ends in the inteſtinal canal, we obſerve a broad, thin, circular border, with a roundiſh hole in the middle. This hole is the inferiour orifice of the ſtomach, called by the Greeks *pylorus*, which ſignifies a porter.

This border is a fold or duplicature of the two inner coats of the ſtomach, the nervoſa and villoſa; and it is formed in part by a faſciculus of fleſhy fibres fixed in the duplicature of the tunica nervoſa, and diſtinguiſhed not only from the other fleſhy fibres of the extremity of the ſtomach, but alſo from thoſe of the inteſtines, by a thin, whitiſh circle, which apppears even through the external or common coat, round the union of the ſtomach and inteſtines.

The figure of the pylorus is that of a ring, tranſverſely flatted, the inner edge of which, or that next the center, is turned obliquely toward the inteſtines, like a broad portion of a funnel. This inner edge runs naturally more or leſs into little plaits or gathers, like the mouth of a purſe almoſt ſhut. It is therefore a kind of ſphincter, which can contract the inferior orifice of the ſtomach, but ſeems not capable of ſhutting it quite cloſe.

The ſtomach receives in general whatever the mouth ſends thither, through the canal of the œſophagus; but its partciular uſe is to receive the aliments, to contain them for a longer or ſhorter time, in proportion as they are more ſolid or fluid, and to digeſt them, that is, to put them in a condition to be turned into that nutritious fluid called chyle.

This operation, which goes by the general name of digeſtion, and by which chylification begins, is performed partly by the ſuccus gaſtricus, which flows continually from the tunica villoſa, and partly by the continual contraction and relaxation of the muſcular coat.

The pylorus, or fleſhy circle of the inferiour orifice of the ſtomach, ſerves to retain the aliments in it, till they have acquired a ſufficient degree of fluidity to paſs eaſily through that opening.

The gentle and alternate motions of the orbicular fibres of the muſcular coat, may aſſiſt in ſending through the pylorus, in the natural way, the aliment that is ſufficiently digeſted. This was called the periſtaltic or vermicular motion, by thoſe who believed that it is ſucceſſively reiterated, like that of earth-worms when they creep.

The ſituation of the ſtomach, which is nearly tranſverſe, is likewiſe of uſe in making the aliment remain long enough in that cavity, and may ſerve to make the length of this ſtay in ſome meaſure arbitary, by means of the different poſtures of the body; for when we lie on the left ſide, the aliment muſt remain longer, than when we lie on the right, *&c.*

The Intestines *in general, and* Inteſtinum Duodenum *in particular.*

Between the pylorus and the very loweſt part of the abdomen, lies a long canal, bent in a great many different directions, by numerous convolutions or turnings, called the inteſtin s.

This canal, thus folded and turned, forms a conſiderable bulk, which fills the greateſt part of the cavity of the abdomen; and it is connected, through its whole extent, to membranous productions or continuations of the peritonæum, principally to thoſe called the meſentery and meſocolon.

The incurvations of the inteſtinal canal form two arches, a ſmall one by which it is connected to the meſentery and meſocolon, and a great one on the oppoſite ſide, which lies looſe. The whole canal is generally about ſeven or eight times as long as the body.

The inteſtines in general are compoſed of ſeveral coats, much in the ſame manner with the ſtomach. The firſt and outermoſt is a continuation of the meſentery, or of ſome other elongation or duplicature of the peritonæum.

This is commonly termed the common coat; and it has a cellular ſubſtance on its inner ſurface, like that of the ſtomach.

The ſecond coat of the inteſtines is fleſhy or muſcular, and made up of two planes, one external, the other internal. The external plane is very thin, and its fibres longitudinal; the internal plane is thicker, and its fibres run tranſverſely round the circumference of the inteſtinal cylinder.

The third coat is called nervoſa, and is ſomething like that of the ſtomach. It has a particular plane, which ſerves as a baſis to ſuſtain it, made up of very fine, ſtrong, oblique fibres, which ſeem to be of the ligamentary or tendinous kind.

This coat ſuſtains two reticular ſubſtances which are both vaſcular, one arterial, the other venal, accompanied by a great number of nervous filaments. Theſe veſſels and nerves are productions of the meſenteric veſſels and nerves; and as they ſurround the whole canal of the inteſtines, ſome anatomiſts have formed them into a diſtinct coat, by the name of tunica vaſculoſa.

The nervous coat ſends off from its inner ſurface a great number of portions of ſepta, more or leſs circular, which contribute to the formation of what are called valvulæ conniventes.

The fourth or innermoſt coat is very ſoft, and is named tunica villoſa. It has the ſame extent with the third coat, which ſupports it, and it lines all the ſepta of that third coat.

The ſmall inteſtines form one continued uniform canal; and though three portions of it have three different names, yet we have no ſufficient marks whereby to diſtinguiſh them, to fix the preciſe extent or length of each portion, to ſettle its juſt limits.

The firſt and ſhorteſt portion of the whole canal, is called duodenum; the ſecond, which is much longer, jejunum; and the third, which is ſtill longer than the ſecond, ileum.

The duodenum having arisen from the pylorus, is immediately bent a little backward, and obliquely downward; then it bends a second time toward the right kidney, to which it is a little connected, and from thence passes before the renal artery and vein, ascending insensibly from right to left, till it gets before the aorta and last vertebræ of the back. It continues its course obliquely forward, by a gentle turn.

Through this whole course, the duodenum is firmly bound down by folds of the peritonæum, especially by a transverse duplicature which gives origin to the mesocolon.

The villi of this intestine are thicker than in the stomach; but the texture of them in man is not like hairs, as they are commonly represented in figures; but rather like that of a fungous granulated substance, composed of an infinite number of very fine papillæ of different figures, in which we see, through a microscope, a multitude of depressed points or pores, by which their whole surface seems to be pierced.

By the same help we observe, on different places of the inner surface of this intestine, several round villous tubercles, rising like small verucæ at different distances from each other.

This substance sustains an infinite number of capillary vessels, of different kinds; for besides the blood-vessels, we sometimes observe a great number of white filaments which run through it, and end at its inner surface, like so many capillary roots of the vessels, called venæ lacteæ.

The internal surface of the duodenum is furnished with a great number of small flat glandular tubercles, raised on the sides, and depressed in the middle, by a kind of fossula; and they are more numerous near the beginning of this intestine than any where else.

These glands appear like little bladders, with the orifices turned toward the cavity of the intestine, and the bodies fixed in the spungy substance next the nervous coat. They furnish a particular viscid fluid.

In the inner surface of the duodenum, almost at the lower part of the first incurvation, and on the shortest side, there is a longitudinal eminence, in the point or apex of which lies a particular opening, which is the orifice of the ductus bilarius, within which the ductus pancreaticus likewise opens.

INTESTINUM JEJUNUM.

The jejunum, so called, because it is oftener found empty than the ilium, begins at the last incurvation of the duodenum, and is there connected to the beginning of the mesocolon.

From thence it bends downward from left to right, and obliquely forward, or from the vertebræ, and makes several convolutions, which lie chiefly in the upper part of the umbilical region. Through all this course it is connected to the mesentery.

The jejunum and ilium may be distinguished by dividing both intestines into five parts; and to allow nearly two fifths to the jejunum, and three fifths and a little more to the ileum.

The coats of the jejunum are nearly of the same structure with those of the duodenum, but thinner.

INTESTINUM ILEUM.

The convolutions of the intestinum ileum surround those of the jejunum on the two lateral and lower sides, and it passes in a winding course from the left side, by the hypogastrium, to the right side, where it terminates a little below the right kidney, joining the intestina crassa.

The structure of the ileum is much the same with that of the jejunum; only the internal duplicatures or valvulæ conniventes decrease gradually both in number and size.

The Intestina Crassa *in general, and* Intestinum cæcum *in particular.*

The great intestines are one continued canal, divided into three portions, like the small ones. This canal begins by a kind of sacculus or bag, which is reckoned the first of the three portions, and called cæcum. The second portion, called colon, is the longest of the three, and is distinguished from them by a great number of particular eminences or convexities, which appear on its outer surface through its whole length. The last portion is named rectum, being more uniform, narrower, thicker, and much shorter than the colon.

The structure of the great intestines is nearly the same with that of the small ones, in regard both to the number and disposition of their coats. They are shorter, and have fewer convolutions, but are much more capacious. The coats in general are stronger, but especially the muscular coat.

The intestinum cæcum is only a round short broad bag, the bottom of which is turned downward, and the mouth or opening upward. It lies under the right kidney, and is hid by the last convolution of the ileum. It is about three fingers breadth in length, and its diameter is more than double that of the small intestines.

On one side of the bottom of the cæcum lies an appendix, resembling a small intestine, nearly of the same length with the cæcum, but very slender. It is termed appendicula vermiformis, from its supposed resemblance to an earth-worm. Its common diameter is not above a quarter of an inch. By one extremity it opens laterally, and a little obliquely, into the bottom of the cæcum; and the other extremity is closed, being sometimes greater, sometimes smaller, than the rest of the appendix.

Through the membranous or common coat of the cæcum, we see three white ligamentary bands, which adhere very closely both to the outer and muscular coat. One of them is hid by the adhesion of the mesocolon; and all the three divide the cæcum longitudinally into three parts more or less equal.

They all unite in the appendicula vermiformis, and cover its whole outer side immediately under the common coat.

INTE-

INTESTINUM COLON.

The colon is the moſt conſiderable of all the inteſtines. From the cæcum, of which it is a continuation, it reaches, in form of an arch, above the umbilical region, and to the lower part of the left hypochondrium. Its continuity is however a little interrupted by the ileum, which advances into the cavity of the colon, and, together with a certain fold of that inteſtine, forms what is called valvula coli.

The whole convex ſide of the colon is divided longitudinally into three parts, by three ligamentary bands, continued from thoſe of the cæcum, and of the ſame ſtructure with theſe. Two of the three bands run on each ſide, along the great curvature of the colon; and the third along the ſmall curvature.

Theſe three longitudinal bands do the office of fræna, between which this inteſtine is through its whole length alternately depreſſed into tranſverſe folds, and raiſed into conſiderable eminences. All the folds are duplicatures, which form portions of valvulæ conniventes in the cavity of the inteſtine; and the eminences form receptacles, called the cells of the colon.

The common coat, on one ſide, is a continuation of the meſocolon; and, on the other ſide, it contributes, by the ſame continuation, to form the omentum.

The arch of the colon begins under the right kidney, near the haunch. It runs up on the foreſide of that kidney to which it is connected, paſſes under the veſicula fellis, which tinges it with a yellow colour at that place, and continues its courſe before the firſt incurvation of the duodenum, to which it adheres, and partly hides it. In this part of its courſe, therefore, there is a remarkable connexion between the colon, duodenum, right kidney, and veſicula fellis.

From thence the arch of the colon runs before the great convexity of the ſtomach, and ſometimes a little lower; then turns backward under the ſpleen, in the left hypochondrium; runs down on the foreſide of the left kidney, to which it is connected; below this kidney turns toward the vertebræ, and terminates there by a double incurvation, or by two oppoſite convolutions, which repreſent in ſome meaſure an inverted roman S.

At the place where the cæcum joins the colon, one portion of the circumference of both is depreſſed, and forms a large fold on the inſide, which advances into the cavity of the inteſtine. It is a little open in the middle, and its extremities are very thick, by reaſon of the mutual duplicature of the coats of the cæcum and colon.

The extremity of the ileum is as it were grafted in the opening of this fold, and ſtrongly united to its ſides by the adheſion of its tranſverſe fibres to the tranſverſe fibres of the cæcum and colon.

This union forms a pretty thick ring, which likewiſe advances into the common cavity of the cæcum and colon, where it is wrinkled or formed into gathers, almoſt like the lower extremity of the œſophagus, the pylorus or inſide of the anus. Its circumference is more or leſs oval; and, by a kind of continuity with the common fold of the cæcum and colon, it forms two productions, which *M. Morgagni* calls the fræna of the valvula coli.

The membranous coat of the extremity of the ileum is continued on the cæcum and colon, without ſinking into any fold, at the place where the ileum enters the colon.

This valvula coli is contrived to hinder the return of the excrements into the ileum; it produces this effect partly as a valve, and partly as a kind of ſphincter.

The capacious arch of the colon is contracted by both extremities to the regio lumbaris, near the kidneys, by two particular ligaments, one on the right ſide, the other on the left, which are only ſmall duplicatures of the peritonæum, more or leſs tranſverſe.

The remaining portion, which forms the two convolutions in form of the roman S, contracts below the left kidney, being narrower there, than lower down. The coats of this portion become gradually thicker and ſtronger, and likewiſe the ligamentary bands, which approach each other by degrees, and ſeem to increaſe in breadth.

INTESTINUM RECTUM AND ANUS.

The laſt of all the inteſtines, is named rectum, or the ſtreight gut, which, properly ſpeaking, is a true continuation of the laſt convolution of the colon; and it is the repoſitory, ſink, and common ſewer, of the whole inteſtinal canal.

The rectum having paſſed below the laſt vertebra of the loins, to the inſide of the os ſacrum, is bent backward on that concave ſide to which it is connected; and having reached the os coccygis, it runs likewiſe in the direction of that bone, and bends a little forward, terminating beyond the extremity of the coccyx.

The figure of this inteſtine varies according as it is full or empty. When empty, it is irregularly cylindrical, and ſinks in by a kind of tranſverſe folds; and in that ſtate, it is about three fingers breadth in diameter, more or leſs. When full, it is wider in proportion to the quantity of fæces, wind, or whatever elſe is contained in it; and it may be extended to the ſize of a large bladder, ſo as to repreſent a kind of ſtomach.

The membranous coat often contains a great quantity of fat, ſpread between it and the muſcular coat, and forming round the inteſtine numerous eminences, in the room of the appendices adipoſæ of the colon.

The muſcular or fleſhy coat is very thick: the longitudinal fibres, which in the other inteſtines are very thin, are in this ſtronger than the circular fibres of the reſt. The ligamentary bands continue to increaſe in breadth, and to approach each other.

The nervous or filamentous and internal coats, are larger here, than in the other inteſtines; and when the rectum is empty, they form a great number of waving rugæ in its cavity, which diſappear, in proportion as that cavity is filled.

The innermoſt coat is very improperly termed villoſa, and ſcarce deſerves the name of papillaris, becauſe of the ſmallneſs of the little corpuſcles ſpread on its ſurface.

It contains a great number of fingl or folitary glands; and it is always moiftened by a mucus of different confiftences difcharged by thefe glands or folliculi.

Near the extremity of this inteftine, the rugæ or folds become in a manner longitudinal; and at laft, towards the circumference of the inner margin of the anus, they form little bags or femilunar lacunæ, the openings of which are turned upward, toward the cavity of the inteftine. Thefe lacunæ are fomething like thofe at the lower extremity of the œfophagus, or upper orifice of the ftomach.

At length the extremity of the rectum contracts, and terminates by a narrow orifice called the anus, the fides of which are difpofed in clofe folds or gathers. This extremity of the inteftine has feveral mufcles belonging to it, fome of which furround it like fphincters, the reft are broad flefhy planes inferted in it, and which being likewife fixed to other parts, fuftain it in its natural fituation, and reftores it to that fituation when difturbed by the force neceffary for the exclufion of the fæces. Thefe latter mufcles are termed levatores ani, the firft go by the general name of fphincters.

Thefe fphincters are three in number, one inteftinal or orbicular, and two cutaneous or oval; whereof one is large, fuperior, and internal; the other fmall, inferior, and external.

The inteftinal or orbicular fphincter of the anus, confifts merely in an augmentation of the inferior portion of the flefhy fibres of the extremity of the rectum.

The cutaneous ligament goes out anteriorly, from the extremity of the os coccygis. It is very flender, and divides into two portions at the orifice of the anus, which run into the membrana adipofa, and are inferted in the fkin on each fide of the anus, by a kind of expanfion; and continuing to divaricate, they are loft on the two fides of the peritonæum.

The interoffeous ligament of the offa pubis is a very ftrong triangular membrane, fixed by two of its edges in the inferior rami of thefe bones, all the way up to their common fymphyfis. The third edge, which is the loweft, is loofe; and this whole membrane, the middle of which is perforated by a particular hole, is ftretched very tight betwcen the two bones, and under their cartilaginous arch, to which it adheres very clofely.

At the lower part of this interoffeous ligament, along its whole lower or loofe edge, lies a digaftric mufcle, fixed by its two extremities in the rami of the offa pubis, its middle tendon lying on the middle of the edge of the ligament.

The cutaneous fphincters have each an anterior and pofterior infertion, ending both ways in a kind of point, and comprehending the orifice of the anus between their middle portions.

They are diftinguifhed from each other by their fituation, by their fize, and by a kind of white cellular line. The greateft of the two appears to be double, and the fmalleft lies neareft the fkin, and adheres moft clofely to it.

They are inferted backward, partly in the apex of the os coccygis, and partly in the contiguous portion of the cutaneous ligament of that bone. Forward their chief infertion is in the middle tendon of the tranfverfalis urethræ; and they have likewife fome connexions to other mufcles of the urethra.

The levatores ani are broad, thin, mufcular portions, fixed by one extremity of their flefhy fibres round the concave fide of the inferior portion of the pelvis, from the fymphyfis of the offa pubis, beyond the fpine of the ifchium. The other extremity of thefe fibres runs down on each fide behind, and under the curvature of the end of the rectum, where they meet together, and unite from the bafis of the os coccygis all the way to the margin of the anus.

We ought likewife to remark, that the margin or edge of the anus is formed by the union of the fkin and epidermis with the internal coat of the rectum; fo that the moft fuperficial portion of that coat feems to be a continuation of the epidermis.

MESENTERIUM & MESOCOLON.

THIS great bundle of inteftines is not left to move at random in the cavity of the abdomen; but artfully bound down by a membranous web, which prevents the inteftinal convolutions from being intangled in each other, and from being twifted or compreffed in all their different ways of meeting; and yet allows them a gentle floating, but limited motion.

This web is diftinguifhed into two portions; one of which, being very broad and very much plaited, connects the fmall inteftines; the other, which is long and incurvated, does the fame office to the greater inteftines.

Thefe two portions are in reality only one and the fame continuation of the membranous lamina of the peritonæum doubled back upon itfelf, and they are diftinguifhed only by their breadth. Taken both together, they form a kind of fpiral roll, more or lefs plaited in its circumference. The firft portion has retained the name of *mefentery*, the other is termed *mefocolon*.

The mefentery begins at the laft incurvation of the duodenum, and runs obliquely from left to right, along the vertebræ of the loins. In this fpace, the membranous portion of the peritonæum is detached on both hands, produces a duplicature by two elongations or particular laminæ applied to each other, and thus forms the mefentery.

It is narrow at its upper and lower parts, but chiefly at the upper. The middle portion is very broad, and the edge of it next the inteftines is every where very much plaited. Thefe plaits or folds are only waving inflections, fuch as may be obferved in the edge of a piece of fhamoy, which has been often drawn through the fingers. They make this edge of the mefentery very long, and they run through about one third of its breadth.

The two laminæ are joined together by a cellular fubftance, which contains glands, veffels, and nerves; and in fome fubjects a great quantity of fat, which keeps the two laminæ a diftance from each other.

Along the whole circumference of the mefentery, the two laminæ are naturally feparated, and applied to the two fides of the fmall inteftines, which they invest by their union, or rather reciprocal continuation on the great curvature

curvature of that canal, and carry it as in a ſcarf or ſling. This is what forms the external or membranous coat of the inteſtines.

The meſocolon is the continuation of the meſentery, which having reached the extremity of the ilium, contracts and changes its name. At this place the particular lamina which is turned to the right ſide, forms a ſmall tranſverſe fold, called *ligamentum coli dextrum*.

Afterwards the meſocolon aſcends towards the right kidney, where it ſeems to be loſt by the immediate adheſion of the colon to that kidney, and to the firſt incurvation of the duodenum. Then it appears again, and, increaſing in breadth, it continues its courſe almoſt tranſverſely under the liver, ſtomach, and ſpleen, where it begins to turn downward, under the left hypochondrium, toward the kidney on the ſame ſide.

Through this whole courſe, the meſocolon extends in breadth, and forms nearly a tranſverſe ſemicircular plane, very little plaited at its great circumference. By this circumference or edge, it is connected to the colon; and hides that ligamentary band of this inteſtine, which runs along its ſmall curvature. By its ſhort or ſmall edge, it forms the triangular caſe of the duodenum; and by its great edge, the external coat of the colon, in the ſame manner as the meſentery does that of the ſmall inteſtines. As it paſſes under the large extremity of the ſtomach, it adheres a little to the lower portion of that extremity, as the diaphragm does to the upper.

Having got below the left kidney, it contracts and forms another tranſverſe fold, called *ligamentum coli ſiniſtrum*. Afterwards it expands again, but not ſo much as in the upper part, and runs down on the left pſoas muſcle, toward the laſt vertebræ of the loins. This deſcending portion is fixed to the convolutions of the colon in the ſame manner as the ſuperior portion is to the arch of that inteſtine.

The inteſtinum rectum is likewiſe inveſted by a particular production of the peritonæum, called commonly by the barbarous name of *meſorectum*. This production is very narrow; and, about the middle of the foreſide of the rectum, it forms a tranſverſe ſemicircular fold, which appears when the inteſtine is empty, but is loſt when it is filled.

GLANDULÆ MESENTERICÆ, VASA LYMPHATICA & LACTEA.

Between the laminæ of the meſentery, a great number of glands lie ſcattered through the cellular ſubſtance. In the natural ſtate, theſe glands are ſomething of the figure of lentils or little round beans; ſome of them being orbicular, others oval, but all of them a little flatted.

Theſe glands are of the number of thoſe that anatomiſts call *glandulæ conglobatæ*, the ſtructure of which is not as yet ſufficiently known. They ſeem to be of a cellular ſubſtance, ſurrounded by a very fine membrane or coat, on which, by the help of microſcopes, we diſcover an intertexture of particular filaments.

Beſides the blood-veſſels which are diſtributed in a reticular manner in the meſenteric glands, and beſides many nervous filaments ſpread through them, we diſcover an infinite number of ſmall veſſels of another kind running from gland to gland.

Theſe veſſels are extremely thin and tranſparent, and furniſhed on the inſide with numerous valves, which appear on the outſide like little ſmall knots very near each other. They go out from each gland by ramifications, as by ſo many roots, and having formed a ſmall trunk, they are again divided, and enter ſome neighbouring gland by the ſame kind of ramifications by which they went out from the former.

They are termed *lymphatic veſſels*, becauſe for the moſt part they contain a very clear, limpid, though mucilaginous ſerum, called *lympha* by anatomiſts. But as they have likewiſe been obſerved to be filled with a white milky fluid, called *chyle*, they have been called *vaſa chylifera*, or *venæ lacteæ*. They have the name of *veins*, becauſe their valves are diſpoſed as thoſe of the ordinary blood-veins, and becauſe the fluid which they contain runs from ſmaller into larger tubes.

They derive their firſt origin from the tunica villoſa of the inteſtines, and chiefly from that of the ſmall inteſtines, by a great number of ſmall capillary roots. From theſe roots there ariſes, between the coats of the inteſtines, a kind of rete mirabile, which ſurrounds almoſt the whole circumference of the inteſtinal canal, between the muſcular and external coat.

This reticular texture of lacteal veſſels keeps cloſe to the external coat, and leaves the canal along with it, on the ſide of the meſentery, where it forms two planes of ramifications, plainly diſtinguiſhed from each other by the cellular ſubſtance, and adhering cloſely to the inſide of the two membranes of the meſentery. In this ſeparate ſtate they run on the laminæ of the meſentery, as far as the firſt meſenteric glands, where they unite again into one plane.

After this union, the lacteal veſſels are diſtributed almoſt uniformly through the whole extent of the meſentery, from its circumference to its origin or adheſion to the vertebræ of the back, between the meſenteric glands, which they join, and form frequent anaſtomoſes or communications.

Having paſſed through the meſentery, the ramifications begin to unite as they approach the ſpina dorſi, and conſequently their number is leſſened, and their ſize increaſed; and having paſſed the laſt meſenteric glands, they terminate about the middle of the adheſion of the meſocolon in ſmall common trunks, which receive a great number of lymphatic veſſels from the glandulæ lumbares, and others below theſe.

The lacteal veſſels which lie between the meſenteric glands and middle adheſion of the meſocolon to the ſpina dorſi, run down on the body of the inferior aorta, between the extremities of the ſmall muſcle of the diaphragm, and terminate in a kind of ciſtern, called by ſome *receptaculum chyli*, by others *receptaculum Pecquetti*.

The greateſt part of the receptaculum chyli lies behind the right portion of the inferior muſcle of the diaphragm, on the right ſide of the aorta, at the union of the laſt vertebra of the back with the firſt of the loins. It is a kind of membranous veſicle, the conformation of which is various in human ſubjects. Sometimes it is of an

an uniform long oval figure, like the veficula fellis; fometimes it is divided by ftrictures, into feveral fmall roundifh bags more or lefs flatted, and fometimes it furrounds the trunk of the aorta like a collar.

It is compofed of very thin coats, and its cavity is divided by fmall pelliculæ or membranous fepta, the difpofition of which is irregular. It is chiefly round the lower part of this receptacle, that the laft lacteal veffels are inferted, fome on the fides, and fome behind the aorta; and they are accompanied by numerous lymphatic veffels. The upper portion is contracted between the aorta and vena azygos, and forms a particular canal, which runs up through the thorax, by the name of *ductus thoracicus*.

HEPAR & VESICULA FELLIS.

THE liver is a large and pretty folid mafs, of a dark red colour, a little inclined to yellow, fituated immediately under the arch of the diaphragm, partly in the right hypochondrium, which it fills almoft intirely, and partly in the epigaftrium, between the appendix enfiformis and fpina dorfi, and terminating commonly in the left hypochondrium.

The figure of the liver is irregular, it being arched or convex on the upper part, unequally concave on the lower, and very thick on the right and back fides. Towards the left and anterior fides its thicknefs decreafes very much, and terminates there by a kind of edge; and it is broader from right to left, than from before backwards.

It may be divided into lateral parts called *lobes;* one of which is termed the *great* or *right lobe*; the other, the *fmall* or *left lobe*. Thefe two lobes are diftinguifhed above, by a membranous ligament; and below very plainly, by a confiderable fciffure lying in the fame direction with the fuperior ligament.

The eminences on the concave fide of the liver belong to the great lobe. The principal eminence is a fort of triangular or pyramidal apophyfis fituated backward near the great fciffure which diftinguifhes the two lobes.

This triangular eminence is termed *lobulus Spigelii*, or fimply the fmall lobe of the liver. One of its angles advances a confiderable way toward the middle of the lower fide of the great lobe, and is loft there. Toward the forefide, there is another eminence lefs prominent but broader; and to this eminence and the former, the ancients gave the general name of *portæ*.

The depreffions on the concave or lower fide of the liver are four in number. The firft is the fciffure that feparates the two lobes, which runs a-crofs the concave fide, from the eminences already mentioned, to the anterior edge, where it terminates by a notch of different depths in different fubjects. This is termed the *great fciffure of the liver*.

The fecond depreffion is fituated tranfverfely between the two eminences of the great lobe, and filled by the finus of the vena portæ. The third depreffion is backward, between the great lobe and lobulus Spigelii, and the vena cava paffes through it. The fourth is a kind of fulcus between the lobulus and fmall lobe of the liver, which in the fœtus ferved to receive a venal canal loft in adults, in whom it appears only as a kind of ligament. This fulcus is in fome meafure a continuation of the great fciffure, and joins the vena cava by an acute angle.

Befides thefe four depreffions, there is one on the fore-part of the great lobe, in which the veficula fellis is lodged; and it fometimes runs as far as the edge, where it forms a fmall notch. We may likewife reckon among thefe depreffions, a fmall fuperficial cavity in the pofterior and lateral part of the lower fide of the great lobe, by which it refts on the right kidney; and likewife a fuperficial cavity in the left lobe, where it runs over the ftomach.

Laftly, on the pofterior edge of the liver, there is a great finus common to both lobes, which gives paffage to the fpina dorfi and œfophagus, near the place where the vena cava defcends.

The convex fide of the liver is commonly connected to the diaphragm by three ligaments, which are only continuations of the membranous lamina of the peritonæum. One lies near the edge of the extremity of each lobe, and one in the middle, and they are accordingly termed the *right*, *middle*, and *left ligaments*. There is a cellular fubftance in the duplicature of each, in which the blood-veffels and lymphatics run, and which fends off a kind of lamina into the fubftance of the liver.

The right ligament fometimes connects the great lobe to the cartilages of the falfe ribs; and the left ligament, or that of the fmall lobe, is often double, and advances toward the middle ligament. This middle ligament begins low, in the great fciffure of the liver, near the eminences called *portæ*, and from thence paffes thro' the anterior notch and over the convex fide of the liver at the union of the two lobes, and is fixed obliquely in the diaphragm.

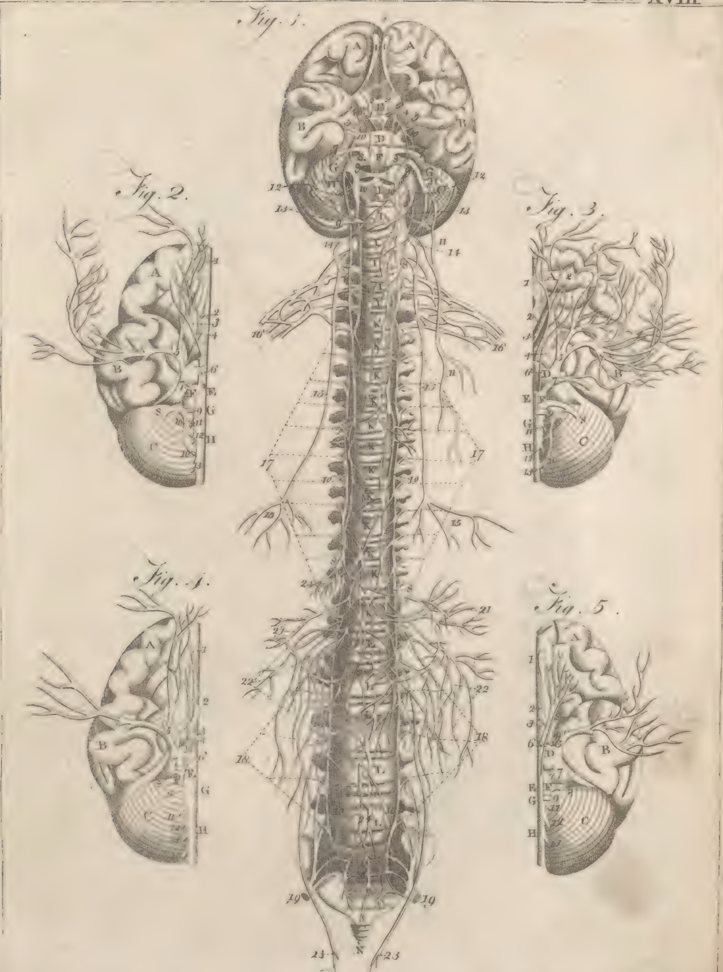
It is likewife fixed along the upper and inner part of the vagina of the right mufculus rectus of the abdomen, in fuch an oblique manner as to be nearer the linea alba below than above.

Befides thefe ligaments the great lobe of the liver is likewife connected to the right ala of the tendinous portion of the diaphragm, not by a ligament, but by a broad and immediate adhefion, without the intervention of the membrane of the peritonæum, which is only folded quite round this adhefion, to form the external membrane of all the reft of the body of the liver.

The middle ligament, called improperly *ligamentum hepatis fufpenforium*, contains in its duplicature a thick white rope, like a round ligament, which was the umbilical vein in the fœtus. Thus the lower part reprefents a falx, the convex edge of which is fharp, and the other rounded.

All thefe ligaments ferve to keep the liver in its proper fituation, and to hinder it from inclining too much towards either fide: But we muft not imagine that any of them ferve to fufpend it; becaufe it is fufficiently fupported by the ftomach and inteftines, efpecially when they are filled.

When the ftomach is empty, or when we faft longer than ordinary, it is a common expreffion to fay *the ftomach pinches us*. As the liver is not then fuftained by the ftomach and inteftines, it defcends by its own weight, and



A. Bell Sculpt.

Fig. 1.

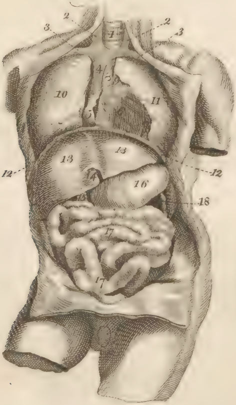


Fig. 2.

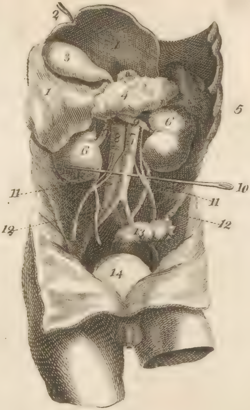


Fig. 3.

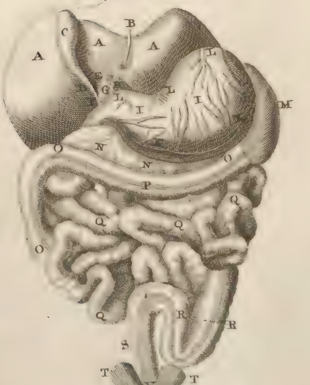


Fig. 4.

Fig. 5.

A. Bell Sculp.

and chiefly by the means of the middle ligament pulls the diaphragm along with it. It is in that place therefore that we have this uneasy ſenſation, and not at the ſuperior orifice of the ſtomach, as is commonly believed.

The liver is compoſed of ſeveral kinds of veſſels, the ramifications of which are multiplied in an aſtoniſhing manner, and form by the intertexture of their capillary extremities, an innumerable collection of ſmall pulpy, friable corpuſcles, which are looked upon to be ſo many organs deſigned to ſeparate from the maſs of blood a particular fluid termed the *bile*.

The greateſt part of theſe veſſels from one end to the other is included in a membranous vagina called *capſula venæ portæ*, or *capſula Gliſſoni*.

The trunk of the vena portæ is ſituated tranſverſely between the broad anterior eminence of the great lobe of the liver, and the root of the lobulus, in a particular ſciſſure, and forms what is called the *ſinus of the vena portæ*. From this ſinus five principal branches go out, which are afterwards divided into millions of ramifications through the whole ſubſtance of the liver.

At this place the vena portæ lays down the common office of a vein, and becomes a kind of artery as it enters, and is again ramified in the liver. The extremities of all theſe ramifications of the trunk of the vena portæ hepatica end in the pulpy friable corpuſcles which ſeem to be thick villous folliculi.

Its in theſe folliculi that the bile is ſecreted, and it is immediately collected in the ſame number of extremities of another kind of veſſels, which unite by numerous ramifications into one common trunk. Theſe ramifications are termed *pori bilarii*, and the trunk *ductus hepaticus*; and the ramifications of theſe two kinds of veſſels are inveſted together by the capſula of the vena portæ.

The blood, deprived of this bilious fluid, is reconveyed to the heart by a great number of venal ramifications, which afterwards unite into three principal branches, beſides others that are leſs conſiderable, that terminate in the vena cava, and are all called by the name of *vena hepatica*.

The capillary extremities of the ramifications of the vena cava, join thoſe of the vena portæ, and accompany them through the liver; and yet the great branches of both veins interſect each other in ſeveral places.

The ductus hepaticus, or trunk of the pori bilarii, having run a little way, joins another canal called *ductus cyſticus* or *veſicularis*, becauſe it comes from the veſicula fellis. Theſe two united ducts form a common trunk named *ductus cholidochus*, becauſe it conveys the bile. This duct having reached the incurvation of the duodenum, inſinuates itſelf through the coats of that inteſtine, and opens into the cavity thereof, not by a round papilla, but by an oblong orifice, rounded at the upper part, and contracted at the lower, like the ſpout of an ewer, or like a common tooth-picker.

The gall-bladder is a kind of ſmall bag ſhaped like a pear, that is, narrow at one end and wide at the other. The wide extremity is termed the *fundus* or *bottom*, the narrow extremity the *neck*, and the middle portion the *body*. About one third of the body of the veſicula lies in a depreſſion on the concave ſide of the liver, from the trunk or ſinus of the vena portæ, where the neck is ſituated to the anterior edge of the great lobe, a little toward the right ſide, where the bottom is placed.

The gall-bladder is compoſed of ſeveral coats; the outermoſt of which is a continuation of that which inveſts the liver, and conſequently of the peritonæum.

The ſecond coat is fleſhy, and made up of two ſtrata, one longitudinal, the other tranſverſe, the fibres of which have nearly the ſame irregular direction with thoſe of the ſtomach; and this diſpoſition of the fibres in theſe viſcera is owing to the different diameters in the ſeveral portions of them, and to their incurvation.

Theſe two coats are connected by a cellular ſubſtance continued between the body of the veſicula and the liver, all the way, to a whitiſh ſtratum, which is looked upon as the third coat of the gall-bladder anſwering to the tunica nervoſa of the inteſtines.

The innermoſt or fourth coat has on the inſide a great number of reticular folds, filled with ſmall lacunæ, like perforated papillæ, eſpecially near the neck of the veſicula where theſe folds are longitudinal, and afterwards form a kind of ſmall pylorus with plaits of the ſame nature with thoſe in the great one. Theſe lacunæ are looked upon to be glands.

That ſide of the body of the veſicula which lies next the liver is connected to that viſcus by a vaſt number of filaments, which run a great way into the ſubſtance of the liver; and among theſe filaments there are ſome ducts which form a communication between the pori bilarii and veſicula. They are moſt numerous near the neck of the veſicula, and they are named *ductus cyſt-hepatici*, or *hepatico-cyſtici*.

The neck of the veſicula is formed by the contraction of the ſmall extremity; and this neck bending afterwards in a particular manner, produces a narrow canal named *ductus cyſticus*.

The neck of the veſicula is nearly of the ſame ſtructure with the other parts. It has on the inſide ſeveral reticular rugæ and ſome folds which appear like fragments of valvulæ conniventes, ſituated very near each other, from the neck to the contraction of the cyſtic duct. The firſt of theſe folds is pretty broad and large, and almoſt circular; the next is more oblique, and ſmaller in ſize; and the reſt diminiſh in the ſame manner.

The bile which paſſes through the ductus hepaticus into the cholidochus, may be called *hepatic*; and that which is collected in the veſicula fellis, may be termed *cyſtic*. The hepatic bile flows continually through the ductus cholidochus into the duodenum, whereas the cyſtic bile flows only by reaſon of plentitude or by compreſſion.

The uſes of the liver ſhall be explained after the deſcription of pancreas, ſpleen, and omentum, all theſe viſcera having a great relation to the liver.

PANCREAS.

The pancreas is a long flat gland, of that kind which anatomiſts call *conglomerate*, ſituated under the ſtomach, between the liver and the ſpleen. Its figure reſembles that of a dog's tongue; and it is divided into two ſides, one ſuperior, the other inferior; two edges, one ante-

rior, the other pofterior; and two extremities, one large, which reprefents the bafis of a tongue, and one fmall and a little rounded like the point of a tongue.

The pancreas is fituated tranfverfely under the ftomach, in the duplicature of the pofterior portion of the mefocolon. The large extremity is connected to the firft incurvation of the duodenum, and from thence it paffes before the reft of that inteftine, all the way to its laft incurvation; fo that a great part of the duodenum lies between the pancreas and the vertebræ of the back. The fmall extremity is fixed to the omentum near the fpleen.

The pancreas is compofed of a great number of foft glandular moleculæ, combined in fuch a manner, as to exhibit the appearance of one uniform mafs on the outfide, the furface of which is rendered uneven only by numerous fmall convexities, more or lefs flatted. When thefe moleculæ are feparated a little from each other, we find along the middle of the breadth of the pancreas, a particular duct, in which feveral fmaller ducts terminate laterally on each fide, like fmall rami in a ftem.

This canal, named *ductus pancreaticus*, or *ductus Virfungi*, is very thin, white, and almoft tranfparent, and the extremity of the trunk opens commonly into the extremity of the ductus cholidochus. From thence it diminifhes gradually, and terminates in a point, next the fpleen. The fmall lateral branches are likewife pretty large near the trunk, and very fmall toward the edges of the pancreas, all of them lying in the fame plane like the branches of the common fern.

The pancreatic duct is fometimes double in man, one lying above the other. It is not always of an equal length, and fometimes runs in a winding courfe, but always in the fame plane; and it is nearer the lower than the upper fide of the pancreas. It pierces the coats of the duodenum, and opens into the ductus cholidochus, commonly a little above the prominent point of the orifice of that canal; and fometimes it opens immediately into the duodenum.

SPLEEN.

The fpleen is a bluifh mafs, fomething inclined to red, and of a long oval figure, being about feven or eight fingers-breadth in length, and four or five in breadth. It is of a foftifh fubftance, and is fituated in the left hypochondrium, between the great extremity of the ftomach, and the neighbouring falfe ribs, under the edge of the diaphragm, and above the left kidney.

The inner or concave fide is divided by a longitudinal groove or fciffure, in two planes or half-fides, one upper, the other lower; and by this groove, the veffels and nerves enter in human fubjects. The fuperior half-fide is broader and more concave than the inferior, being proportioned to the convexity of the great extremity of the ftomach. The inferior half-fide lies backward on the left kidney, and forward on the colon; and fometimes this fide of the fpleen appears to have two fuperficial cavities, one anfwering to the convexity of the ftomach, the other to that of the colon. The convex fide of the fpleen is turned to the left ribs.

It is connected to the ftomach, by the veffels called *vafa brevia*; to the extremity of the pancreas, by ramifications of the fplenic artery and vein; and to the omentum, by ramifications which the fame artery and vein fend to the fpleen, and which run in the longitudinal groove.

It is connected to the edge of the diaphragm by a particular membranous ligament of different breadths in different fubjects, fixed in its convex fide, fometimes near the upper edge, and fometimes near the lower.

The ftructure of the fpleen is not eafy to be unfolded in man, and it is very different from that of the fpleens of brutes, from which both public and private demonftrations are commonly made.

Its coverings adhere to it fo clofely in man, that it is difficult to diftinguifh the common from the proper coat; whereas in fome brutes, fuch as oxen, fheep, *&c.* we eafily find two coats feparated by a cellular fubftance. This covering feems to be no otherwife a continuation of the peritonæum than by the intervention of the omentum and mefocolon.

In man the fubftance of the fpleen is almoft wholly vafcular. In oxen the fubftance of the fpleen is chiefly reticular, and in fheep it is cellular. In oxen and fheep there are no venal ramifications, but inftead thereof only open finufes difpofed like branches, except a fmall portion of a venal trunk perforated on all fides, at the extremity of the fpleen.

In the human fpleen we fee fomething like glandular corpufcles, as in thofe of other animals; and there are numerous venal ramifications through its whole extent. Between thefe ramifications we every where obferve an appearance of extravafated blood, lying in a kind of filamentary tranfparent and very delicate fubftance expanded through the whole fpleen.

This filamentary fubftance, having furrounded all the ramifications, terminates in almoft imperceptible cells which communicate with each other.

OMENTUM & APPENDICES EPIPLOICÆ.

The omentum is a large, thin, and fine membranous bag, furrounded on all fides by numerous portions of fat, which accompany and even inveft the fame number of arteries and veins adhering clofely to each other.

The greateft part of it refembles a kind of flat purfe or a fportfman's empty pouch, and is fpread more or lefs on all the fmall inteftines from the ftomach to the lower part of the regio umbilicalis. Sometimes it goes down to the lower part of the hypogaftrium, and fometimes does not reach beyond the regio epigaftrica. It is commonly plaited or folded in feveral places, efpecially between the bands of fat.

It is divided into a fuperior and inferior, an anterior and pofterior, and a right and left portion. The fuperior portion is in a manner divided into two borders, one of which is fixed along the great curvature or convex fide of the arch of the colon, and the other along the great curvature of the ftomach. The commiffure or union of thefe two borders on the right fide, is fixed to the common ligament or adhefion of the duodenum and colon,

colon, and to the contiguous parts of theſe inteſtines. That on the left ſide is fixed to the longitudinal ſciſſure of the ſpleen, to the extremity of the pancreas, and to the convex ſide of the great extremity of the ſtomach. It is likewiſe fixed to the membranous ligament which ſuſtains the ductus cholidochus, and connects it to the vena portæ ventralis.

Below theſe adheſions, the other portions, that is, the anterior, poſterior, two lateral and inferior portions, which laſt is the bottom of the ſucculus epiploicus, have commonly no fixed connections, but lie looſe between the fore-ſide of the cavity of the abdomen and inteſtines.

The membrane of the omentum is through its whole extent made up of two extremely thin laminæ joined by a cellular ſuſtance; the quantity of which is very conſiderable along the blood-veſſels, which it every where accompanies in broad bands, proportioned to the branches and ramifications of theſe veſſels. Theſe cellular bands are more or leſs filled with fat according to the corpulency of the ſubject.

Beſides this large membranous bag, there is another much ſmaller, which differs from the large one, not only in ſize, but alſo in figure, ſituation and connexion; and this is the *little omentum.* This ſmall bag is fixed by its whole circumference, partly to the ſmall curvature of the ſtomach, and partly to the concave ſide of the liver before the ſinus of the vena portæ, ſo as to ſurround and contain the prominent portion of the lobulus.

The little omentum is thinner and more tranſparent than the other, and its cavity diminiſhes gradually from the circumference to the bottom. Its ſtructure is pretty much the ſame with that of the great omentum, it being compoſed of two laminæ, with a mixture of the ſame portions of fat, which are conſiderably finer than in the other.

The fatty appendices of the colon and rectum appear to be a kind of ſmall omenta or appendices epiploicæ. They are ſituated at different diſtances along theſe inteſtines, being particular elongations of their common or external coat. They are of the ſame ſtructure with the great omenta, and there is a cellular ſubſtance contained in their duplicature, more or leſs filled with fat, according as the ſubject is fat or lean.

USES *of the Abdominal Viſcera.*

THE inteſtines in general finiſh what the ſtomach had begun. The alimentary pulp having been ſufficiently prepared by the ſuccus gaſtricus, or lymph of the ſtomach, undergoes a further change by the inteſtinal lymph, bile, and pancreatic juice, by which the milky liquor called *chyle* is produced, and this liquor rendered fluid enough to enter the lacteal veſſels through the tunica villoſa of the ſmall inteſtines, while the groſſer portion of the aliment continues its courſe, and becoming gradually thicker as it advances toward the great inteſtines, is there collected by the name of *fæces.*

The valve of the colon, which might more properly be termed *ſphincter* or *pylorus* of the ileum, hinders the fæces from returning into the ſmall inteſtines.

The glandular lacunæ of the inteſtines furniſh continually a kind of mucilage, which not only defends the internal coat from the acrimony of the fæces, but ſerves alſo to lubricate theſe fæces in proportion to their different degrees of ſolidity.

The inteſtinum rectum is the laſt reſervatory of the fæces. The great thickneſs of its muſcular coat, and the great number of longitudinal fibres by which this thickneſs is chiefly formed, enable it to yield to the collected fæces to ſo great a degree, as to repreſent a large bladder or ſtomach. The muſculi levatores ani ſerve to ſuſpend the lower portion of this inteſtine, eſpecially when full; and it is partly by the contraction of theſe muſcles which overcome the ſphincter of the anus, that the fæces are diſcharged out of the body. Theſe ſphincters form the third pylorus of the whole alimentary canal.

The meſentery and meſocolon connect the inteſtines, in ſuch a manner, as that they cannot be twiſted or run into knots, without hindering them from ſliding and yielding to each other according to the different poſtures of the body, or according as they are more or leſs empty or full.

The adheſions of the meſentery form the convolutions of all the ſmall inteſtines into a large bundle, irregularly round, which fills a great part of the cavity of the abdomen, from the epigaſtrium downward.

The meſocolon by its adheſion to the colon forms a kind of ſeptum tranſverſum, between the ſmall inteſtines and the viſcera contained in the epigaſtrium; and this ſeptum ſupports the liver and ſtomach under the arch of the diaphragm, juſt as much as it is ſuſtained by the inteſtines.

The breadth of the meſentery and meſocolon affords a large extent to the ramifications of the arteries, veins, and nerves, diſtributed through them by innumerable communications and anaſtomoſes, by means of which any portion of the inteſtines may be ſupplied, though the principal branch which leads to it ſhould happen to be compreſſed or obſtructed.

The cellular ſubſtance in the duplicature of the meſentery and meſocolon, ſerves not only for a ſoft bed to all theſe ramifications, but alſo to contain thoſe collections of fat neceſſary for the formation of the bile; and the cellular ſubſtance of the meſentery has likewiſe one uſe peculiar to it, which is to inveſt the lymphatic glands and lacteal veſſels, and upon this account it is thicker than that of the meſocolon.

The lacteal veſſels being firſt formed by a copious reticular texture round the circumference of the inteſtines, reſembling the vaſcular network of that canal, and afterwards uniting every where through the duplicature of the meſentery, with the arterial ramifications which they likewiſe accompany in many places; it is eaſy to conceive, that the pulſation of the meſenteric arteries muſt propel the chyle in the lacteal veſſels from the inteſtines to the receptaculum chyli, that motion being ſuitable to the direction of their valves.

The liver is the principal organ for the ſecretion of the bile. The villi of that immenſe number of glandular cells of which it is compoſed, filtrate continually from the blood of the vena portæ ſmall drops of bile, which afterwards inſinuate themſelves into the pori bilarii, and

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are in part lodged in the vesicula fellis, and in part run directly into the duodenum.

The spleen, omentum, appendices epiploicæ, adipose strata of the mesentery, and those of the great intestines, and even the pancreas, with the whole series of glands in the intestinal canal, seem to contribute to the formation of the bile, as so many auxiliary or rather preparatory organs.

The vesicular bile appears to be more exalted than that in the hepatic duct; and by meeting in the ductus cholidochus, they seem to compose a third kind of bile, which without the cystic or vesicular bile would perhaps be too mild, and too acrid without the hepatic. This bile mixes in the duodenum with the pancreatic juice, and with that of the intestinal glands; and from this mixture a fluid results, which is proper to separate the chylous matter from the gross and useless part of the alimentary pulp, as it comes from the stomach.

RENES & URETERES.

THE kidneys are two pretty solid, glandular bodies, situated in the posterior part of the cavity of the abdomen, on each side of the lumbar vertebræ, between the last false ribs and ossa ileum. The right kidney lies under the great lobe of the liver, and is consequently lower than the left, which lies under the spleen.

The figure of the kidneys resembles that of a large bean, their circumference being convex on one side, and concave on the other. The concave side is turned to the vertebræ, and the convex side the opposite way.

In each kidney we observe a fore and back side, an upper and lower extremity, a great and small curvature, and a convexity and concavity.

The back-side is broader than the fore-side; and the upper extremity is a little broader and more incurvated than the lower. The depression in the small curvature is oblong and uneven, resembling a sinus, surrounded by several tubercles; and as it is turned a little toward the fore-side, this side is something narrower than the other.

The kidneys are surrounded by a very loose membranous and cellular covering, called *membrana adiposa*, because in fat persons the cells of this substance are filled with fat.

The proper coat or membrane of the kidneys is composed of two laminæ, between which there is likewise a very fine cellular substance, which may be made sensible by blowing through a pipe between the two laminæ.

The external lamina is very thin, and adheres closely to the internal lamina, by means of the cellular substance. The internal lamina penetrates every where, by numerous elongations, into the substance of the kidney, from which it cannot be separated without tearing.

The surface of the external lamina is very smooth, polished and glistening, and it renders the whole surface of the kidney very even and uniform.

The blood-vessels having entered the kidneys, are ramified every way; and these ramifications send out other capillary rami, which go all the way to the surface, where they appear like irregular stars, and furnish the proper membrane of the kidneys.

The proper membrane having surrounded the kidney all the way to the sinus, joins the vessels at that place, and accompanies all their ramifications through the body of the kidney, in form of a vagina or capsula.

We may distinguish three kinds of substances in the kidney; an exterior substance, which is thick, granulated, and in a manner cortical; a middle substance, which is medullary and radiated, called *striata*, *sulcata*, or *tubularis*, because it seems to be made up of radiated tubes; and an inner substance, which is only a continuation of the second, and terminates on the inside by papillæ, for which reason it is called *papillaris*.

The papillæ, which are only a continuation of the medullary substance, are often a little paler than that substance. They are ten or twelve in number, very distinct from each other, resembling the same number of cones, with very broad bases and obtuse apices.

At the point of each papilla we see, even without a microscope, in a small depression, several very small holes, through which little drops may be perceived to run when the papillæ are compressed. These are little drops of urine, which being filtrated, partly in the cortical, partly in the medullary or tubular substance, do afterwards pass through the substance of the papillæ, and are discharged by these orifices.

Each papilla lies in a kind of membranous calix or infundibulum, which opens into a common cavity called the pelvis. This pelvis is membranous, being of the same structure with the calices, of which it is a continuation; and its cavity in man is not uniform, but distinguished into three portions, each of which contains a certain number of infundibula or calices, together with the papillæ which lie therein.

At the place where these infundibula surround the bases of the papillæ, they send productions into the medullary or radiated substance of the kidney, which accompany the blood-vessels, and serve for capsulæ or vaginæ to all the vascular arches, both arterial and venal, and to their different ramifications, quite through the cortical substance, and as far as the surface of the kidney.

After the infundibula have contracted in a conical form round the apices of the papillæ, each of them forms a small short tube or gullet, which, uniting at different distances along the bottom of the sinus of the kidney, form three large tubes, which go out from the sinus in an oblique direction from above downwards, and immediately afterwards unite into one trunk.

This trunk becomes a very long canal, called the ureter. In men the three tubes supply the place of what is called the pelvis in brutes, and might properly be called the roots or branches of the ureters than the pelvis. The ureters are commonly two in number, one for each kidney.

The situation of the trunk, and of the roots and branches of each ureter, with respect to the renal artery and vein, is in the following manner: The artery is in the upper part of the sinus, and partly before the vein. The vein is about the middle, and between the artery and ureter. The ureter is in the lower part, a little behind the vein, and it is partly surrounded by one branch of the artery.

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The ureters run down obliquely, and with a very ſmall degree of inflection, from the kidneys to the lateral parts of the inner or anterior ſide of the os ſacrum, and paſſing between the rectum and bladder they terminate in the laſt of theſe viſcera.

They are compoſed of three proper coats; the firſt of which, that ſurrounds the reſt, is of a whitiſh colour, and of a very compact filamentary texture, being ſtretched with difficulty, and appearing like a filamentary ſubſtance degenerated. The next coat is of a reddiſh colour, ſtronger than the firſt, and made up of different ſtrata of fibres, which interſect each other; but it is very hard to determine, whether they are muſcular, or ſimply membranous.

GLANDULÆ RENALES, *vulgo* CAPSULÆ ATRABILARIÆ.

Immediately above each kidney, lies a glandular body, called by the ancients capſulæ atribilariæ; by others capſulæ renales, renes ſuccenturiati, and glandulæ renales. They are ſituated on the upper extremity of each kidney a little obliquely, that is, more toward the inner edge and ſinus of the kidney than toward the outer convex edge.

Each gland is an oblong body with three ſides, three edges, and two points, like an irregular creſcent with its great or convex edge ſharp, and the ſmall concave edge broad. Its length is about two thirds of the greateſt breadth of the kidney, and the breadth of its middle portion is about one third of its extent between the two extremities, ſometimes more, ſometimes leſs. Its colour is a dark yellow.

It has one anterior, one poſterior, and one lower ſide, which laſt may be termed the baſis; and it has one upper, and two lower edges, whereof one is anterior, the other poſterior. The upper edge may be called the criſta, and the two lower edges the labia.

The ſurface of theſe glands is uneven; the foreſide is the broadeſt, and the lower ſide or baſis the narroweſt. Along the middle of the anterior ſide, a ridge runs from the edge of the inner extremity, a little above the baſis, to the point of the other extremity, and divides this ſide into two equal parts, like the middle rib of the leaf of a tree; and on the lower ſide, under the baſis, there is a kind of raphe or ſuture.

The blood-veſſels of theſe glands come from the arteriæ, and venæ renales, and diaphragmaticæ, and likewiſe from the aorta and vena cava, from the arteria cæliaca, *&c.* Theſe veſſels are termed the capſular arteries and veins; and as they enter the glands, they ſeem to be inveſted by a vagina.

In the inſide of theſe capſulæ, there is a narrow triangular cavity, the ſurface of which is full of ſhort ſtrong villi of a yellowiſh colour; but in children it is reddiſh, and of a dark brown in aged people. The ſides of this cavity are connected by a great number of filaments; and they appear to be wholly glandular, that is, to be filled with very fine ſmall folliculous corpuſcles.

This cavity contains an unctuous viſcid liquor, of a yellowiſh red colour, which with age changes gradually into a yellowiſh purple, a dark yellow, and a black yellow; and ſometimes it is perfectly black; but even then, if it be ſpread thin on a large ſurface, it appears yellow.

The uſes of theſe renal glands have not as yet been diſcovered; and all that we know about the liquor contained in them, is, that it reſembles the bile. They are very large in the fœtus, and diminiſh in adults.

VESICA URINARIA.

The bladder is a kind of membranous and fleſhy pouch or bottle, capable of dilatation and contraction, ſituated in the lower part of the abdomen, immediately behind the ſymphyſis of the oſſa pubis, and oppoſite to the beginning of the inteſtinum rectum. The figure of it is nearly that of a ſhort oval. It is broader on the fore and back ſides, than on the lateral parts; rounder above than below when empty, and broader below than above when full.

It is divided into the body, neck, and bottom; into an anterior, poſterior, and two lateral parts. The upper part is termed the fundus or bottom; and the neck is a portion of the lower part, which is contracted like the gullet of ſome veſſels.

The bladder is made up of ſeveral coats. That part of the external coat which covers the upper, poſterior and lateral ſides of the bladder, is the true lamina or membrane of the peritonæum; and the reſt of it is ſurrounded by a cellular ſubſtance, by the intervention of which, the peritonæum is connected to the muſcular coat.

The proper coats are three in number, one muſcular, one nervous, and one villous, which is the innermoſt. The muſcular coat is compoſed of ſeveral ſtrata of fleſhy fibres; the outermoſt of which are moſtly longitudinal; the next to theſe are more inclined toward each hand; and the innermoſt, more and more oblique; and they become at length almoſt tranſverſe.

The nervous coat is nearly of the ſame ſtructure with the tunica nervoſa of the ſtomach.

The internal coat is ſomething granulated and glandular, and a mucilaginous ſerum is continually diſcharged through it, which moiſtens the inner ſurface of the bladder and defends it againſt the acrimony of the urine.

At the top of the bladder, above the ſymphyſis of the oſſa pubis, we obſerve a ligamentary rope, which runs up between the peritonæum and the linea alba of the abdomen, all the way to the navel, diminiſhing gradually in thickneſs as it aſcends. This rope had a particular uſe in the fœtus, as ſhall be ſaid in another place. It is ſufficient to add here, that it is in part originally a production of the inner coats of the bladder, which production is termed urachus.

This rope is compoſed likewiſe of two other ligamentary elongations, which are the extremities of the umbilical arteries. Theſe arteries come from the hypogaſtricæ, run up by the ſides of the bladder, and remain hollow and filled with blood, even in adults, as high as the middle of the bladder, through all which ſpace they likewiſe ſend off ramifications. Afterwards they loſe their cavity, and become ligamentary as they aſcend.

At the upper part of the bladder, they approach each other; and, joining the urachus, form that rope, which may be termed the ſuperior ligament of the bladder.

The lower part of the bladder, which deſerves the name of *fundus* much better than the upper part, is perforated by three openings, one anterior, and two poſterior. The anterior opening is formed by an elongation of all the proper coats, in form of a gullet, turned much in the ſame manner with the inner orifice of the roſtrum of the head of an alembic. This elongation is called the neck of the bladder, the deſcription of which belongs to that of the parts of generation in men.

The other two openings in the true fundus of the bladder, are formed by the ureters, which, in their courſe downward already deſcribed, run behind the ſpermatic veſſels, and then behind the lower part of the bladder, approaching each other. Each ureter lies between the umbilical artery and vas deferens of the ſame ſide, the artery lying on the outſide of the ureter, and the vas deferens on the inſide.

Afterwards they get between the vaſa deferentia and the bladder, croſſing theſe canals: and then at about a finger's breadth from each other, they begin to pierce the coats of the bladder. They run a little way between the muſcular and nervous coats, and open into the bladder obliquely, ſomething nearer each other than when they firſt entered its coats.

The orifices of the ureters in the bladder, are ſomething oval, and narrower than the cavity of the ureters immediately above them. The edge of theſe orifices is very thin, and ſeems to be formed merely by the union of the internal coat of the bladder with that of the ureters.

Beſides the ligaments already mentioned, there are likewiſe two ſmall ones, by which the anterior part of the true fundus of the bladder is connected to the oſſa pubis, which ſhall be deſcribed with the neck and ſphincter after the hiſtory of the parts of generation in both ſexes.

THE PARTS OF GENERATION IN MALES.

The ſpermatic arteries go out moſt commonly from the anterior part of the inferior aorta, near each other, and about an inch lower than the arteriæ renales.

They run down obliquely in the poſterior part of the abdomen, within the cellular ſubſtance of the peritonæum, paſſing inſenſibly from behind forward; and ſo parting gradually more and more from the aorta, they croſs over the foreſide of the ureters, and run through the openings or rings of the abdominal muſcles, along with the elongations or productions of the cellular portion of the peritonæum.

They are ſmall at their origin; and in their courſe downward, they give off pretty conſiderable lateral ramifications to the membrana adipoſa, peritonæum, and alſo to the meſentery.

They ſometimes paſs through the areolæ, or meſhes of the ſpermatic veins; and before they go out of the abdomen, they are divided into very fine rami, which run in a more or leſs winding courſe, almoſt parallel to each other.

Afterwards they enter the cellular productions of the peritonæum, which ſerve them for vaginæ. They do not fluctuate indifferently from one ſide to the other of theſe vaginæ; but are connected along their inner ſurface by thin membranous laminæ, which are likewiſe continuations of the cellular ſubſtance of the peritonæum.

The arteries continue the ſame winding courſe within theſe vaginæ, paſſing before the vaſa deferentia, which are likewiſe contained in them; and at length they terminate by ramifications in the epididymes and teſtes.

The teſtes are two glandular bodies, ſituated near each other, without the abdomen, below the interſtice between the groins in an adult. The ancients named them *didymi* or *gemini*. Their ſize is nearly that of a pigeon's egg, and they are of an oval figure, a little flatted at each ſide. We may conſider in each teſticle, two extremities, two edges, and two ſides. One extremity is ſituated forward, and a little upward; the other backward, and a little downward; and their edges lie upward and downward.

At the upper edge, they have each an appendix, called epididymis, together with which it is involved in ſeveral coverings; and they are both ſuſpended in a common covering, called the ſcrotum.

Each teſticle is a ſpermatic gland formed by a vaſt number of fine whitiſh tubes, folded and twiſted in different manners, and diſtributed in different faſciculi, between membranous ſepta; the whole being ſurrounded by a ſtrong common covering, named *tunica albuginea*.

Theſe ſepta are diſpoſed longitudinally, divaricating from each other on one ſide, and approaching on the other. They approach each other along one edge of the teſticle, and terminate in a long narrow whitiſh body, as in a kind of axis.

From thence they divaricate in a regular manner, and are fixed by their oppoſite edges in the inner ſurface of the tunica albuginea, of which they appear to be a continuation. This white body may be termed the nucleus of the teſticle.

From this deſcription, we ſee that all theſe ſepta are not of an equal breadth; that the interſtices between them are in ſome meaſure trangular; and that the extent of the ſmall tubes, which lie therein, muſt be very conſiderable. They have been reckoned to amount to many ells, by taking the ſum of all their ſeveral portions: and they may be eaſily unfolded by a long maceration, which deſtroys the delicate ſubſtance by which all their folds and convolutions are connected and tied down.

All theſe ſmall canals ſeem to terminate by a ſmaller number of common trunks at the white body or nucleus already mentioned; which trunks do afterwards pierce the upper part of the anterior extremity of the teſticle, and are diſpoſed in ſeveral folds along the lateral external part of the upper edge, all the way to the poſterior extremity. From this union ariſes a long whitiſh plaited faſciculus or bundle, called epididymis, or appendix to the teſticle.

The epididymis thus formed, may be reckoned a production of the teſticle, or a kind of teſtis acceſſorius; and

and it refembles in fome meafure an arch fupported by its center or frame. It is more contracted at the middle, than at the extremities, by which it is clofely united to thofe of the tefticle.

Between its extremities it does not immediately touch the tefticle, but is only loofely connected to it, by the duplicature of a very fine and almoft tranfparent membrane, as by a kind of ligament. This membrone is the continuation and duplicature of the tunica albuginea or proper coat of the tefticle, which having fupplied the place of a ligament to the epididymis afterwards invefts it.

The epididymis is flat, a little concave on the under fide, or that next the tefticle, irregularly convex on the upper fide, or that turned from the tefticle; and thefe two fides are diftinguifhed by two angular edges; by the innermoft of which, it is connected to the tefticle, in the manner already faid; but the outer edge and flat fide are loofe and free.

The anterior extremity or head of the epididymis arifes from the tefticle; and the pofterior extremity or tail, which likewife adheres very clofely to it, is incurvated from behind, forward, and a little upward, and contracting by degrees, forms a particular canal, termed vas deferens, which fhall be defcribed after the fcrotum.

The fcrotum is the cutaneous covering of the teftes. Outwardly, it is a bag common to both, formed by a continuation of the fkin of the neighbouring parts, and commonly very uneven, having a great number of rugæ on its outer furface. Interiorly it is flefhy, and forms a mufcular capfula for each tefticle, termed dartos.

The exterior or cutaneous portion of the fcrotum is nearly of the fame ftructure with the fkin in general, of which it is a continuation; only it is fomething finer, and it is likewife plentifully ftored with febaceous glands and bulbs or roots of hairs.

Though it is a common covering for both tefticles, it is neverthelefs diftinguifhed into two lateral parts by a fuperficial and uneven prominent line which appears like a kind of future, and from thence has been termed *raphe*.

This line is a continuation of that which divides in the fame manner the cutaneous covering of the penis; and it is continued through the perinæum, which it divides likewife, all the way to the anus. It is only fuperficial, and does not appear on the infide of the fkin.

The inner furface of this cutaneous bag is lined by a very thin cellular membrane, through which bulbs and glands appear very diftinctly when we view its infide.

The dartos, or flefhy portion of the fcrotum, is a true cutaneous mufcle; the fibres of which are for the moft part ftrongly connected to the fhin, running through the cellular fubftance which lies between thefe two portions in place of a membrana adipofa, but without the leaft appearance of fat. This mufcle is thin, and by the difpofition of its fibres forms a bag with two cavities, or two fmall bags joined laterally to each other, and contained within the cutaneous portion.

The lateral parts of thefe two bags, which are turned from each other, are longer than thofe which are joined together; and by this union a feptum is formed between the teftes, which may be called mediaftinum fcroti.

The raphe or future already mentioned adheres to the edge of this feptum, and thereby braces down the middle of the cutaneous portion, which from thence appears to have in part two cavities.

The aponeurotic or ligamentary expanfion of the dartos is fixed in the ramus of the os pubis, between the mufculus triceps and the origin of the corpus cavernofum of the fame fide, all the way to the lower part of the fymphyfis of thefe bones.

The vafa deferentia are two white folid flatted tubes, one lying on the right fide, the other on the left. From the epididymis, of which they are continuations, each of them runs up in the cellular vagina of the fpermatic veffels, as high as the openings in the abdominal mufcles; the blood-veffels lying forward, and the vas deferens behind them.

This fafciculus, thus formed by the blood-veffels, vas deferens, and their common covering, is termed the fpermatic rope. The covering is fmoother on the outer than on the inner fide, and for that reafon it has been looked upon as a vagina; the internal fubftance of which is moft cellular, and connects all the veffels together, while the external forms a covering to inveft them.

The vas deferens having reached the membranous lamina of the peritonæum, where that lamina runs over the orifice of the vagina, feparates from the blood veffels, and runs backward, in form of an arch, in the cellular fubftance of the peritonæum, as far as the neareft fide of the bladder.

It paffes afterwards behind the body of the bladder, to which it adheres very clofely, as alfo to the lamina of the peritonæum which covers it, and then continues its arched courfe towards the neck of the bladder, where both vafa deferentia meet, and their arches terminate.

In this courfe, the vas deferens paffes behind and croffes the neighbouring umbilical artery; croffes the extremity of the ureter of the fame fide, in its paffage between that extremity and the bladder; and having got behind the bladder, it meets the vas deferens of the other fide between the infertions of the ureters, and they run down together to the neck of the bladder.

This canal, which at the origin of the epididymis is pretty large and plaited, becomes immediately afterward fmaller and fmoother, and continues in that form till it gets behind the bladder, where it begins again to be larger and more uneven.

It arifes from the angular portion or pofterior extremity of the epididymis, and from thence runs forward in a very oblique courfe, on the pofterior half of the epididymis, where it is a little incurvated as it joins the backfide of the fpermatic veffels.

The cavity of the vas deferens is cylindrical, though the whole tube is flat, and its external circumference oval, and the cavity inlarges as it paffes behind the bladder. The termination of thefe canals muft be referred to the hiftory of the urethra.

The particular coverings of the teftes are commonly called coats; and they are reckoned to be three in number; the tunica mufculofa, named cremafter, vaginalis and albuginea. The firft two are common to each tefticle, and to the fpermatic rope that belongs to it; and the third is peculiar to the tefticle alone.

The

The tunica vaginalis is the moſt conſiderable of the three, and muſt be deſcribed firſt, in order to conceive the ſtructure and connection of the cremaſter, which is very improperly called a coat. The albuginea has been already deſcribed with the teſtes.

The tunica vaginalis is a continuation of the vagina of the ſpermatic rope, which, as it approaches the teſticle, is gradually dilated, and forms two capſulæ, one contained within the other, the external being the longeſt and broadeſt at bottom; ſo that there is a void ſpace there left between them, in which the teſticle is lodged.

The inner ſurface of this coat is lined by a fine membrane, which ſtrengthens the bottom of the vagina, and forms a kind of diaphragm, which prevents all communication between the vagina of the ſpermatic rope and the tunica vaginalis of the teſticle.

The cremaſter, improperly termed a coat, is a thin muſcle or fleſhy plane, which runs down round the vagina of the ſpermatic rope, and terminates in the tunica vaginalis of the teſticle.

It ſurrounds almoſt the whole vagina, and afterwards expands itſelf on the upper and external part of the tunica vaginalis, in which it is inſerted and loſt.

It ariſes partly from the ligamentum Fallopii, and partly from the lower edge of the internal oblique muſcle of the abdomen; and on this account it ſeems ſometimes to ariſe from the ſpine of the os ilium.

The corpora cavernoſa are two ligamentary and very limber tubes, united laterally to each ſide, through the greateſt part of their length, and ſolid at their two extremities, two of which are connected together, and rounded like the end of a finger; the other two divaricate, like the branches of the *greek* Y, and diminiſhing gradually in ſize after the divarication, terminate in an oblique point. Theſe divaricated and pointed extremities may be called the *roots*, and the round extremities the *heads*.

Theſe two bodies are almoſt cylindrical, being round, and of an equal diameter from the roots to the heads, where they are in ſome meaſure conical. The ligamentary ſubſtance of their ſides is elaſtic, and compoſed of fine cloſe fibres, which are partly tranſverſe, and partly more or leſs oblique.

The cavity of theſe ligamentary tubes is entirely filled by a ſtrong cellular or cavernous ſubſtance, which does not ſeem to be a continuation of the ſubſtance of the ſides. Theſe cells communicate with each other, and are always more or leſs full of blood, reſembling pretty much the cellular ſubſtance of the ſpleen; only with this difference, that the ſides of the cells are thicker in theſe cavernous bodies, and without any additional ſubſtance.

By the union of the two corpora cavernoſa, two external grooves are formed, one on the upper ſide, the other on the lower. The lower groove is ſomething broader than the upper, and it is filled through its whole length by a third tube, narrower than the corpora cavernoſa, called the urethra.

The roots of the corpora cavernoſa are fixed, each, to the edge of the ſmall ramus of the os iſchium and os pubis. They meet at the ſymphyſis of the oſſa pubis, where each of them becomes a cylindrical tube, and unites with the other in the manner already ſaid.

The heads or rounded extremities join the baſis of a diſtinct body, called the glans, which is an expanſion of the urethra, and cloſely united to it.

By the union of the corpora cavernoſa from their roots to their round extremities or heads, a particular ſeptum is formed by the tranſverſe fibres of both. Between the fibres of this ſeptum ſeveral ſmall void ſpaces are left, by which the corpora cavernoſa communicate with each other.

The urethra is the third ſpungy tube which compoſes the penis, and it adheres to the corpora cavernoſa through the whole length of the inferior groove formed by their union. It differs from the other two, both as it is narrower, and as it forms a true hollow canal. Its ſubſtance is ſpungy or cavernous, except a ſmall portion next the bladder, and its inner and outer ſurfaces are membranous.

It is at firſt no more than a membranous canal continued from the anterior opening of the bladder, at the place called the neck of the bladder

About a finger's breadth and an half from its origin, it joins a cavernous ſubſtance like that of the two other tubes, only ſmaller, which ſurrounds it through the whole extent of the inferior groove of the corpora cavernoſa.

But before this ſpungy ſubſtance begins to ſurround the urethra, it forms a diſtinct oblong body, like a pear or onion, which is connected only to the lower convex ſide of the canal, and afterwards, being ſplit on each ſide, inveſts it quite round. This body is called the bulb of the urethra, being larger than any other part of that canal, and divided interiorly by a very fine membranous ſeptum, into lateral parts; and therefore when it is inflated, it appears to be double or with two heads.

The firſt portion of the urethra, or that which is not covered by the cavernous ſubſtance, and which from the bladder to the bulb is only a membranous canal, is ſuſtained by a large ſolid whitiſh maſs, of the figure of a cheſnut, and ſituated between the bladder and the bulb of the urethra, its baſis being toward the bladder, the apex or point toward the urethra, and the ſides lying upward and downward.

This body is termed the proſtates, from a greek word that expreſſes its ſituation before the veſiculæ ſeminales, and implies a plurality, becauſe it appears to be divided into two lateral lobes, by a hollow groove which runs through its upper ſide from the baſis to the apex. The firſt portion of the urethra lies in this groove, adhering very cloſely to the proſtates which ſurround it.

The body of the proſtates lies on the inteſtinum rectum, and the apex is under the internal labium of the cartilaginous arch of the oſſa pubis. The inner ſubſtance is ſpungy, but very compact; and in each lobe there are ſeveral folliculi which open into the firſt portion of the urethra, toward the bottom of the groove.

The ſpungy ſubſtance of the urethra, having reached the extremity of the corpora cavernoſa, forms a large head, called the *glans*, which crowns the three ſpungy pillars,

pillars; with this difference however, that it is a continuation of the spungy substance of the urethra, and only adheres to the extremity of the corpora cavernosa without any direct communication.

The figure of the glans is that of a rounded cone, a little flattened at the lower part, and with an oblique prominent basis, the circumference of which is something greater than that of the corpora cavernosa.

The spungy substance of the glans is thick and uniform next the corpora cavernosa; but next the urethra, it is perforated by a continuation of that canal, and is there no thicker than the urethra before the formation of the glans.

Therefore the canal of the urethra does not lie in the middle of the glans, but continues its direct course thro' the lower flat side of it, all the way to the extremity, where it terminates by an oblong orifice.

All the convex surface of the glans is covered by a fine villous substance; and that again by a fine membrane, resembling the red part of the lips. The circumference of the basis of the glans has a double row of small papiliæ, which may be reckoned sebaceous glands, from which a thick matter is discharged.

At the bottom of the cavity of the first portion of the urethra, or that which lies within the prostates, there is a small oblong oval eminence, pretty large on the back part, and terminating forward in a point, called *caruncula* or *verumontanum*. The large portion of it is commonly perforated by two holes, sometimes only by one, and very seldom by three; and these are the excretory orifices of the vesiculæ seminales. Each orifice has a small thin membranous border, which may serve for valves to the excretory ducts of the vesiculæ.

On each side of the large portion of the caruncula, there are five or six holes ranked in form of a crescent round its lateral parts; which are the orifices of the excretory ducts of the prostates that come from the folliculi already mentioned, and run in an oblique course to the orifices, in a kind of membranous duplicature.

The vesiculæ seminales are soft whitish knotty bodies, about three or four fingers breadth in length, one in breadth, and about three times as broad as thick, situated obliquely between the rectum and lower part of the bladder, in such a manner, as that their superior extremities are at a distance from each other, and their lower extremities united between those of the vasa deferentia, of which they imitate both the obliquity and the incurvation.

They are irregularly round on the upper part, and their breadth decreases gradually from thence. By the union of their lower extremities, they form a kind of fork, the branches of which are broad, and bent like rams horns. These extremities are very narrow, and form a small neck, which runs behind the bladder toward its orifice, and continues its course in the groove of the prostates, through the substance of the contiguous portion of the urethra, till its extremities pierce the caruncula in the manner already said.

The inner substance of the vesiculæ is plaited, and in a manner distinguished into several capsulæ, by contorted folds. Their external surface is covered by a fine membrane, which serves for a border and frænum to the folds, and is a true continuation of the cellular substance of the peritonæum. The vesiculæ may easily be unfolded, and all their contorsions streightened, and by this means they become much longer than in their natural state.

Their inner surface is villous and glandular, and continually furnishes a particular fluid, which exalts, refines, and perfects the semen, which they recive from the vasa deferentia, and of which they are the reservatories for a certain time.

The passage of the vasa deferentia into the vesiculæ is very particular. It was observed, that these canals are incurvated behind the bladder, and that their contracted extremities unite at that place. They unite in an angle, and run between the contiguous extremities of the vesiculæ; and this union is so close, that the adhering portions seem to form only one middle septum, between two small tubes, each of which is formed, partly by the extremity of one vas deferens, and partly by that of the neighbouring vesicula.

This lateral union of the extremities of the vas deferens, and vesicula seminalis on each side, forms likewise a kind of short septum, which terminates in a crescent, like a small semilunar valve, and the extremity of the vas deferens is narrower than that of the vesicula. By this mechanism, the fluid contained in each vas deferens has liberty to enter the contiguous vesicula, but that contained in the vesicula cannot return into the other canal.

Afterwards the two small tubes, formed each by the extremities of the vas deferens and vesicula, run in between the basis of the prostates, and canal of the urethra; and perforating the sides of that canal obliquely, they terminate in the caruncula.

The inside of the canal of the urethra is lined by a fine membrane, full of capillary blood-vessels; and its surface is perforated by a great number of oblong holes or small lacunæ of different sizes, the largest lying near the glans.

These lacunæ, or orifices of the excretory ducts of the same number of small glands, are dispersed through the substance of the urethra. Which ducts run for some way in the spungy substance, along the convex side of the internal membrane of the urethra, and open obliquely from behind, forward into the great canal. The edges of the lacunæ are semilunar, or like a crescent.

A little way from the beginning of the cellular substance of the urethra, we meet with two lacunæ more considerable than the rest, and their ducts are very long. These lacunæ and ducts lead to two glandular bodies, situated on the two convex sides of the spungy substance of the urethra near the bulb. Each of them is about the size of a cherry-stone, but they are oblong and flat, and covered intirely by the muscles called *acceleratores*. These two bodies are commonly called *prostatæ inferiores*.

The cavity of the urethra resembles nearly that of a small writing pen. It is not every where round, and towards the gland becomes broader and flatter on one side, especially in the gland itself, where there is a kind of oval or navicular fossula.

This canal terminates at the extremity of the glans by

by a narrow oblong orifice or fiſſure, which is much leſs than the reſt of the cavity. The commiſſures of this ſmall fiſſure are turned one toward the convex, the other toward the flat ſide of the glans; and the labia of the fiſſure are its lateral parts; and it ſeems to be ſurrounded by fleſhy fibres.

The præputium is a continuation of the ſkin of the pubis and ſcrotum, and it adheres all the way to the baſis of the glans. The reſt of the cutaneous integument covers the glans without adheſion, and terminates by an opening. This portion is named præputium, and along the whole lower or back ſide, both of the whole integument in general, and of the præputium in particular, there runs a fine ſuture, which is a continuation of the raphe of the perinæum and ſcrotum.

The inner ſurface of the præputium is lined with a fine membrane from the opening all the way behind the baſis of the glans; and the ſame membrane is folded from behind, forward, round the glans, forming the proper integument thereof, and covering very cloſely its whole villous ſurface, as far as the orifice of the urethra, where it joins the membrane, which lines the inſide of that canal.

This proper membrane of the glans, and internal membrane of the præputium, form conjointly along the flat part of the glans, from its baſis to the orifice of the urethra, a membranous duplicature, which like a ſeptum or mediaſtinum divides this part into two lateral portions, and limits the motions of the præputium; for which reaſon it is called *frænum præputii*.

The ſurface of the internal membrane of the præputium diſcharges a fluid which prevents it from adhering to the glans.

Several muſcles are inſerted in the parts which we have deſcribed in this paragraph.

The firſt two muſcles are commonly termed erectores, or acceleratores urinæ. The next two are called acceleratores. The four ſmall muſcles, two of which are ſuperior, and two inferior, may be called proſtatici.

The erectores lie along the roots of the corpora cavernoſa; each of them being fixed by one extremity very obliquely, in the internal labium of the ramus of the os iſchium, from the tuberoſity upward. From thence it accompanies the root of the corpus cavernoſum, all the way to the ſymphyſis of the oſſa pubis, and is fixed by its other extremity in the corpora cavernoſa, near their union; where the fibres of both bodies meet, and are reciprocally expanded over both corpora. They lie a little lower, and more interiorly, than the roots of theſe cavernous bodies.

The muſculi tranſverſi, called alſo triangulares, are two long. narrow, fleſhy faſciculi, inſerted each by one extremity in the root or beginning of the ramus of the os iſchium; from whence they run tranſverſely along the edge of the interoſſeous ligament of the oſſa pubis, as far as the apex of the proſtates, where their other extremities meet, and form commonly a kind of digaſtric muſcle, the middle of which gives inſertion to the muſcles of the urethra, and to the cutaneous ſphincters of the anus.

The ſuperior proſtatici are two thin planes, fixed in the upper part of the inſide of the ſmall rami of the oſſa pubis; from whence they are ſpread over and inſerted in the proſtates. Their inſertions in the oſſa pubis are on one ſide of thoſe of the obturatores interni.

The proſtatici inferiores are ſmall tranſverſe planes, each of which is fixed in the ſymphyſis, between the ramus of the os pubis and os iſchium, and from thence runs tranſverſely, till it meets its fellow from the other ſide under the proſtates, to which they are both ſtrongly connected, and they ſerve like a girth to ſuſtain theſe glands.

THE PARTS OF GENERATION IN FEMALES.

THE parts of generation in females are ſeveral in number, ſome of them external, and ſome internal; and they are all ſubordinate to one principal internal part, called the *uterus*.

The uterus lies between the bladder and inteſtinum rectum. It is a body inwardly hollow, outwardly of a whitiſh colour, of a pretty ſolid ſubſtance, and, except in time of pregnancy, of the figure of a flat flaſk, being in adults about three fingers breadth in length, one in thickneſs, and two in breadth at one end, and ſcarcely one at the other.

The broadeſt portion is termed the *fundus*, and the narroweſt the *neck*. Its ſituation is oblique, the fundus being turned backward and upward, and the neck forward and downward; the broad ſides lie next the rectum and bladder, and the narrow ſides are lateral.

The cavity of the uterus is flat, and reſembles an oblong triangle, the ſhorteſt ſide of which anſwers exactly to the fundus, and the two longeſt ſides lie one on the right-hand, the other on the left.

Of the three angles of this cavity, the two which terminate the fundus are perforated each by a narrow duct, which with difficulty admits a hog's briſtle. The third angle forms a flat duct wider than the former, which perforates the neck of the uterus lengthwiſe, and terminates at the extremity of that neck by a tranſverſe opening.

This opening is termed the internal orifice of the uterus; and, in the natural ſtate, is narrower than the duct of the collum uteri, ſo that only a ſmall ſtilet can be paſſed through it. At the edge of this orifice, are ſeveral ſmall holes, anſwering to the ſame number of glandular corpuſcles, which diſcharge a viſcid lympha.

The inner ſurface of the cavity of the uterus is lined by a very fine membrane, which at the fundus or broad portion is ſmooth and even, but in the narrow portion which leads to the orifice it is wrinkled in a particular manner.

The portion of this membrane, which covers the bottom of the cavity, is perforated by a great number of conſiderable holes, through which ſmall drops of blood may be obſerved to paſs when the whole uterus is compreſſed.

In the narrow part, which anſwers to the collum, each ſide

ſide is divided into two lateral parts, by a kind of prominent longitudinal line, which is larger in the upper or anterior ſide, than in the lower or poſterior.

On each ſide of theſe two longitudinal lines, there are lines or rugæ obliquely tranſverſe, and diſpoſed like branches, the longitudinal lines repreſenting trunks. Between and round theſe rugæ, there are ſmall lacunæ, through which a mucilaginous fluid is diſcharged that cloſes the orifice of the uterus.

The ſubſtance of the body of the uterus is ſpungy and compact, with a copious intertexture of veſſels. Its thickneſs is nearly equal and uniform in the ſides and edges, but the fundus is thicker toward the middle, than toward the two angles, where the thickneſs decreaſes gradually. The edges are likewiſe much thinner near theſe angles, than near the extremity of the neck.

The uterus is covered by a portion of the peritonæum, which ſerves it for a coat, and is the continuation of that which covers the bladder and inteſtinum rectum, running up from the lower and poſterior part of the bladder, over the anterior part of the uterus, and from thence over the fundus, and down the backſide, and afterwards going to the rectum.

On each lateral part or edge of the uterus, this portion of the peritonæum forms a broad duplicature, which is extended on each ſide, more or leſs directly to the neighbouring lateral parts of the pelvis, forming a kind of membranous ſeptum between the anterior and poſterior halves of the cavity of the pelvis; and it is afterwards continued in a looſe manner with the peritonæum, on the ſides of the pelvis.

Theſe two broad duplicatures have the name of *ligamenta lata*, and *veſpertilionum alæ*. The upper edge of each is partly double or folded, forming two ſmall diſtinct duplicatures.

The laminæ of all theſe duplicatures are connected by a cellular ſubſtance, in the ſame manner as the other duplicatures of the peritonæum; and they contain the Fallopian tubes, the ovaria, a part of the ſpermatic veſſels, and of thoſe that go to the body of the uterus, the ropes called the round ligaments, the nerves, *&c.*

The ovaria are two whitiſh, oval, flat, oblong bodies, ſituated on the ſides of the fundus uteri; to which they are fixed by a kind of ſhort round ligament, and incloſed, together with it, in the duplicature of the poſterior pinion of the ligamenta lata.

They are compoſed of a compact ſpungy ſubſtance, and of ſeveral little balls, or tranſparent veſiculæ, which are called *ova*. The ſpungy ſubſtance ſurrounds each of theſe veſiculæ very cloſely, and ſeems likewiſe to furniſh them with diſtinct ſpungy coverings or calices.

The ligaments of the ovaria lie in the edges of the poſterior pinions of the ligamenta lata, much in the ſame manner as the umbilical vein in the anterior or umbilical ligament of the liver. They are round ropes of a filamentary texture, fixed by one extremity to the corner of the fundus uteri, a little above and behind the level of that fundus. They were formerly believed to be hollow, and looked upon as vaſa deferentia.

The Fallopian tubes are two flaccid, conical and vermiform canals, ſituated more or leſs tranſverſely on each ſide of the uterus, between the fundus and the lateral parts of the pelvis, and included in the anterior duplicatures or pinions of the ligamenta lata.

Each of them is fixed by its narrow extremities in the corner of the fundus uteri, into which it opens, though by ſo narrow a duct, as hardly to admit a large briſtle. From thence their diameter augments by degrees all the way to the other extremity, where it is about one third part of an inch. The body of the tubæ goes in a winding courſe, and their large extremity is bent toward the ovaria.

Theſe large extremities are irregularly round, and terminate by a narrow orifice, a little plaited, and turned toward the ovarium, where it preſently expands in form of a membranous fringe, full of plaits and inciſures. Theſe fringes are called the broad ends of the Fallopian tubes.

Theſe tubes are compoſed of fleſhy fibres, whereof ſome are longitudinal, and ſome obliquely circular, with an intertexture of another very fine ſubſtance.

The anterior pinions of the ligamentum latum ſerve for a common or external coat to both tubæ, and alſo to connect them, in the ſame manner as the meſentery connects the inteſtines. From thence the tubæ, and eſpecially their fringes, come to be looſe.

The pubes is that broad eminence at the lower part of the hypogaſtrium, between the two inguina, on which hairs grow at a certain age. This eminence is owing to a particular thickneſs of the membrana adipoſa which cover the fore-part of the oſſa pubis, and ſome ſmall portions of the neighbouring muſcles.

The longitudinal cavity which reaches from the middle and lower part of the pubes, within an inch of the anus, was by the ancients termed *ſinus*; and they called the lateral parts of that cavity *alæ*, which is a more proper name than that of *labia*, commonly given to them. The places where the alæ are joined above and below are termed commiſſures; and may likewiſe be called the extremities or angles of the ſinus.

The alæ are more prominent, and thicker above than below, and lie nearer each other below than above. They are chiefly compoſed of the ſkin, cellular ſubſtance, and fat. The exterior ſkin is a continuation of that of the pubes and inguina. It is more or leſs even, and furniſhed with a great number of glandular corpuſcles, from which a whitiſh ceruminous matter may be expreſſed; and after a certain age it is likewiſe covered in the ſame manner with the pubes.

The inner ſide of the alæ is ſomething like the red portion of the lips of the mouth; and it is diſtinguiſhed every where from the external ſide by a kind of line, in the ſame manner as the red portion of the lips from the reſt of the ſkin; being likewiſe thinner and ſmoother than the outward ſkin. A great number of pores are obſervable in it, and alſo numerous glandular corpuſcles which furniſh a liquor more or leſs ſebaceous.

Near the inner edge of the inner ſurfaces of the alæ, on each ſide of the orifice of the canal of the uterus, we find a ſmall hole more viſible than the reſt. Theſe two holes are termed lacunæ; and they communicate by two ſmall ducts with the ſame number of follicular bodies lying

ing in the ſubſtance of the alæ, and which may be looked upon as ſmall proſtates anſwering to the glandulæ proſtaticæ in males. When compreſſed, they diſcharge a viſcid liquor.

Above the ſuperior commiſſure, a thin flat ligament runs down from each ſmall branch of the oſſa pubis, which penetrates the fat in the ſubſtance of each ala, and is loſt therein inſenſibly near the edge. Theſe may be looked upon as the ligamenta ſuſpenſoria of the alæ. The inferior commiſſure of the alæ is very thin, or like a membranous ligament, and, together with the neighbouring parts of the inner ſides, it forms a foſſula, termed navicularis or ſcaphoides. The ſpace between the inferior commiſſure and anus, termed perinæum, is about a large finger's breadth in length.

The other external parts are ſituated in the ſinus, and hid by the alæ. Directly under the ſuperior commiſſure lies the clitoris, with its covering called præputium. A little lower is the orifice of the urethra; and below that is the orifice of the great canal of the uterus. The circumference of this orifice is bordered either by a membranous circle, called hymen, or by fleſhy portions, termed carunculæ myrtiformes. On each ſide of the clitoris begins a very prominent fold like a criſta, which runs down obliquely on each ſide of the orifice of the urethra. Theſe folds are termed nymphæ, and they might likewiſe be named criſtæ clitoridis.

The clitoris appears at firſt ſight like a ſmall imperforated glans. Its upper and lateral ſides are covered by a kind of præputium, formed by a particular fold of a portion of the inner ſide of the alæ; which appears to be glandular, and to diſcharge a certain moiſture, and its inſide is granulated.

By diſſection, we diſcover in the clitoris a trunk and two branches, as in the penis, made up of a ſpungy ſubſtance, and of very elaſtic coats, but without any urethra. The trunk is divided into two lateral parts of a middle ſeptum, from the bifurcation, to the glans, where it is inſenſibly loſt.

The bifurcation of the trunk is on the edge of the cartilaginous arch of the oſſa pubis; and the branches which reſemble the roots of the corpora cavernoſa are inſerted in the inferior rami of theſe bones, and in thoſe of the oſſa iſchium, where they terminate by degrees; but there is ſometimes a membranous tube on each ſide, which reaches to the tuberoſity of the iſchium.

The trunk of the clitoris is ſuſtained by a ligamentum ſuſpenſorium fixed in the ſymphyſis of the oſſa pubis, and containing this trunk in its duplicature, nearly as in the other ſex.

Four muſcles or faſciculi of fleſhy fibres are inſerted in the trunk of the clitoris, two on each ſide. One of them runs down on the foreſide of the neighbouring corpus cavernoſum, and is inſerted by a tendinous or aponeurotic portion, partly in the extremity of the corpus cavernoſum, and partly in the tuberoſity of the iſchium. Theſe two muſcles are called erectores.

The other muſcle on each ſide lies under the former, and runs down on the ſide of the urethra and great orifice of the uterus, all the way to the anus; increaſing gradually in breadth in its paſſage, and terminating partly like that which is called *accelerator* in males.

Theſe two muſcles ſurround very cloſely the lateral parts of the urethra, and of the great orifice. They expand very much as they deſcend, and are ſpread on the lower and lateral parts of the great orifice; for which reaſon ſeveral anatomiſts have looked upon them as muſcular ſphincters.

The nymphæ, criſtæ clitoridis, or, as they may likewiſe be termed, alæ minores ſive internæ, are two prominent folds of the inner ſkin of the great or external alæ, reaching from the præputium of the clitoris to the two ſides of the great orifice of the uterus. They begin very narrow, and, having increaſed in breadth in their courſe downward, they are again contracted at their lower extremity.

They are of a ſpungy ſubſtance, intermixed with glands, ſeveral of which may be perceived by the naked eye. Their ſituation is oblique, their upper extremities lying near each other, and the lower at a much greater diſtance. In married women they are more or leſs flaccid and decayed.

By the urethra in females, we mean the urinary duct, the orifice of which is between the nymphæ below the glans of the clitoris. The ſides of this orifice are a little prominent and wrinkled, and perforated by ſmall lacunæ, from which a viſcid or mucilaginous liquor may be ſqueezed.

The body of the urethra is a ſpungy duct of the ſame ſtructure as in males, but much ſhorter, ſituated directly under the trunk of the clitoris, and above the great canal of the uterus, adhering to each of theſe canals between which it lies, by membranous filaments. It paſſes under the cartilaginous arch of the oſſa pubis, and terminates by an oblique opening at the neck of the bladder.

The great canal is ſituated below the urethra, and above the extremity of the inteſtinum rectum, a little obliquely, being more raiſed on the inner and back part, than on the outer and fore part.

Its inner or poſterior extremity joins the extremity of the body of the uterus, and ſurrounds its orifice much in the ſame manner as the duodenum ſurrounds the pylorus, or as the ilium is ſurrounded by the cæcum and colon.

The anterior extremity forms the great orifice, which lies under that of the urethra, and above the foſſula of the inferior commiſſure of the alæ.

The body of the canal is chiefly made up of a ſpungy ſubſtance, interwoven with numerous blood-veſſels; and it is commonly longer and narrower in virgins, than in married women.

Its inner or concave ſurface, has ſeveral tranſverſe rugæ, and is covered by a particular membrane. The rugæ are formed by oblong narrow eminences, incurvated like portions of arches, placed very near each other, and diſpoſed in ſuch a manner as to divide the cavity of the canal into an upper and lower ſide.

By the union of the extremities of the upper and lower rugæ, a kind of raphe or ſuture is formed on the right and left ſides; and both arches are ſometimes interſected in the middle, and ſo form two half-arches.

In

In general, theſe arches are very conſiderable in young perſons; become gradually more ſuperficial in married women, and are quite loſt in time of delivery.

The inner or poſterior extremity of this great canal ſurrounds the orifice of the uterus, a little obliquely, in ſuch a manner, as that the upper ſide of the canal lies very near the orifice, and the lower ſide at a greater diſtance from it; and this makes the extremity of the uterus appear to advance more into the canal on the lower than on the upper part.

The exterior or anterior extremity of the great canal in virgins, and eſpecially before the firſt eruption of the menſes, is commonly bordered by a circular membranous fold, of different breadths, more or leſs ſmooth, and ſometimes ſemilunar, which in ſome ſubjects leaves but a very ſmall opening, in others a large opening, and in all renders the external orifice narrower than the reſt of the cavity. This fold, called hymen, is formed by the union of the internal membrane of the great canal with that on the inſide of the alæ, and repreſents a membranous circle of different breadths, and ſometimes uneven.

This membranous circle is commonly ruptured after the conſummation of marriage; is quite loſt in delivery; and afterwards only ſome irregular portions of it remain, which, from their ſuppoſed reſemblance to myrtle leaves, have been termed carunculæ myrtiformes. This circle may likewiſe ſuffer ſome diſorder by too great a flux of the menſes, by imprudence, levity, and other particular accidents.

Each ſide of the anterior portion of the great canal is covered exteriorly by a thin broad cavernous and vaſcular plexus, called the plexus retiformis of that canal. Theſe two planes run down on each ſide of the clitoris behind the nymphæ, and likewiſe cover the urethra like a collar, before they are ſpread on the great canal.

This plexus is ſtrictly united to the muſcular portions commonly taken for accelerators or conſtrictors, lying between theſe portions and the lateral parts of the urethra and of the great canal.

Sect. III. *Of the Thorax.*

By the thorax, we commonly underſtand all that part of the body which anſwers to the extent of the ſternum, ribs, and vertebræ of the back, both outwardly and inwardly.

The thorax is divided into the anterior part called commonly the breaſt, the poſterior part called the back, and the lateral parts called the right and left ſides.

The external parts of the thorax, beſides the ſkin and membrana adipoſa, are principally the mammæ, and the muſcles which cover the ribs and fill the ſpaces between them. In the mammæ we ſee the papillæ or nipples, and a ſmall coloured circle, which ſurrounds them.

The internal parts of the thorax are contained in the large cavity of that portion of the trunk, called the middle venter, or cavity of the breaſt. This cavity is lined by a membrane named pleura, and divided into two lateral cavities by a membranous ſeptum named mediaſtinum, which is a production or duplicature of the pleura.

Theſe parts are the heart, pericardium, trunk of the aorta, a portion of the aſpera arteria and of the œſophagus, the ductus lacteus or thoracicus, the lungs, *&c.*

The hard parts, which form the ſides of the cavity of the thorax, are the twelve vertebræ of the back, all the ribs, and the ſternum. The ſoft parts, which complete the ſides, are the membrane called pleura, which lines the cavity, and the muſculi inter-coſtales, ſterno-coſtales, and diaphragma.

All theſe hard and ſoft parts taken together repreſent a kind of cage, in ſome meaſure of a conical figure, flatted on the foreſide, depreſſed on the backſide, and in a manner divided into two nooks by the figure of the vertebræ of the back, and terminated below by a broad arched baſis inclined backward. The intercoſtal muſcles fill up the interſtices betwixt the ribs, and ſo complete the ſides of the cavity; the baſis is the diaphragm, and the pleura not only covers the whole inner ſurface of the cavity, but, by forming the mediaſtinum, divides it into two, one on the right hand, the other on the left.

MAMMÆ.

The name of mammæ, or breaſts, is given to two eminences more or leſs round, ſituated in the anterior and a little toward the lateral parts of the thorax.

The body of the mammæ is partly glandular, and partly made up of fat; or it is a glandular ſubſtance mixed with portions of the membrana adipoſa, the cellulous pelliculæ of which ſupport a great many blood-veſſels, lymphatics, and ſerous or lactiferous ducts, together with ſmall glandular molleculæ which depend on the former; all of them being cloſely ſurrounded by two membranes continued from the pelliculæ.

The innermoſt of theſe two membranes, which is in a manner the baſis of the body of the mamma, is thick and almoſt flat, adhering to the muſculus pectoralis major. The ſecond or external membrane is thinner, forming a particular integument for the body of the mamma, more or leſs convex, and adhering cloſely to the ſkin.

The corpus adipoſum of the mamma in particular, is a ſpungy cluſter, more or leſs interlarded with fat, or a collection of membranous pelliculæ, which, by the particular diſpoſition of their outer ſides, form a kind of membrane in ſhape of a bag, in which all the reſt of the corpus adipoſum is contained. The anterior or outer portion of this bag, or that which touches the ſkin, is very thin; but that ſide next the pectoralis major, is thick.

The glandular body contains a white maſs, which is merely a collection of membranous ducts, narrow at their origin, broad in the middle, and which contract again as they approach the papilla, near which they form a kind of circle of communication. They are named ductus lactiferi.

The coloured circle or diſk is formed by the ſkin, the inner ſurface of which ſuſtains a great number of ſmall glandular molleculæ. They appear very plainly all over the areola, even on the outſide, where they form little flat heights or eminences at different diſtances quite round the circle.

The tubercle which lies in the center of the areola, is termed papilla, or the nipple. In women with child, or who give ſuck, it is pretty large, and generally longer or higher than it is thick or broad.

The texture of the nipple is ſpungy, elaſtic, and liable to divers changes of conſiſtence, being ſometimes harder, ſometimes more flaccid. It ſeems to be made up chiefly of ligamentary faſciculi, the extremities of which form the baſis and apex of the nipple.

Between theſe ſpungy and elaſtic faſciculi lie ſeven or eight particular tubes, at ſmall diſtances from each other, and all in the ſame direction. Theſe tubes end at the baſis of the papilla in the irregular circle of communication of the lactiferous ducts, and at the apex, in the ſame number of almoſt imperceptible holes or orifices.

The uſe of the mammæ in the nouriſhment of children is known to all the world: But it is not certainly known what the papillæ and areolæ in males can be deſigned for. Milk has been obſerved in them, in children of both ſexes.

PLEURA AND MEDIASTINUM.

The pleura is a membrane which adheres very cloſely to the inner ſurface of the ribs, ſternum, and muſculi inter-coſtales, ſub-coſtales, and ſterno-coſtales, and to the convex ſide of the diaphragm. It is of a very firm texture, and plentifully ſtored with blood-veſſels and nerves, in all which it reſembles the peritonæum.

The cellular portion goes quite round the inner ſurface of the thorax, but the membranous portion is diſpoſed in a different manner. Each ſide of the thorax has its particular pleura, intirely diſtinct from the other, and making as it were two great bladders, ſituated laterally with reſpect to each other in the great cavity of the breaſt, in ſuch a manner as to form a double ſeptum or partition running between the vertebræ and the ſternum, their other ſides adhering to the ribs and diaphragm.

This particular duplicature of the two pleuræ is termed mediaſtinum. The two laminæ of which it is made up are cloſely united together near the ſternum and vertebræ; but in the middle, and toward the lower part of the fore-ſide, they are ſeparated by the pericardium and heart. A little more backward they are parted in a tubular form by the œſophagus, to which they ſerve as a covering; and in the moſt poſterior part, a triangular ſpace is left between the vertebræ and the two pleuræ from above downward, which is filled chiefly by the aorta.

The mediaſtinum does not commonly terminate along the middle of the inſide of the ſternum, but inclines toward the left ſide.

The ſurface of the pleura turned to the cavities of the breaſt, is continually moiſtened by a lymphatic ſeroſity which tranſudes through the pores of the membranous portion.

The pleura ſerves in general for an inner integument to the cavity of the thorax. The mediaſtinum cuts off all communication between the two cavities, and hinders one lung from preſſing on the other when we lie on one ſide. It likewiſe forms receptacles for the heart, pericardium, œſophagus, *&c.*

THYMUS.

The thymus is an oblong glandular body, round on the upper part, and divided below into two or three lobes, of which that toward the left hand is the longeſt. In the fœtus it is of a pretty large ſize, leſs in children, and very little in aged perſons.

The greateſt part of the thymus lies between the duplicature of the ſuperior and anterior portion of the mediaſtinum, and the great veſſels of the heart; from whence it reaches a little higher than the tops of the two pleuræ, ſo that ſome part of it is out of the cavity of the thorax.

Its particular inward ſtructure and ſecretions are not as yet ſufficiently known to determine its uſes, which however ſeem to be deſigned more for the fœtus than for adults.

COR.

The heart is a muſcular body ſituated in the cavity of the thorax on the anterior part of the diaphragm, between the two laminæ of the mediaſtinum. It is in ſome meaſure of a conical figure, flatted on the ſides, round at top, and oval at the baſis. Accordingly, we conſider in the heart the baſis, apex, two edges, and two ſides, one of which is generally flat, the other more convex.

Beſides the muſcular body, which chiefly forms what we call the heart, its baſis is accompanied by two appendices called auriculæ, and by large blood-veſſels; all theſe are included in a membranous capſula, named pericardium.

It is hollow within, and divided by a ſeptum which runs between the edges into two cavities, called *ventriculi*, one of which is thick and ſolid, the other thin and ſoft. This latter is generally termed the right ventricle, the other the left ventricle, though in their natural ſituation the right ventricle is placed more anteriorly than the left.

Each ventricle opens at the baſis by two orifices, one of which anſwers to the auricles, the other to the mouth of a large artery; and accordingly one of them may be termed the auricular orifice, the other the arterial orifice. The right ventricle opens into the right auricle, and into the trunk of the pulmonary artery; the left, into the left auricle, and into the great trunk of the aorta. At the edges of theſe orifices are found ſeveral moveable pelliculæ, called valves by anatomiſts; of which ſome are turned inward, toward the cavity of the ventricles, called triglochines or tricuſpides; others are turned towards the great veſſels, called ſemilunares or ſigmoidales. The valvulæ tricuſpides of the left ventricle are likewiſe termed mitrales.

The inner ſurface of the ventricles is very uneven, many eminences and cavities being obſervable therein. The moſt conſiderable eminences are thick fleſhy productions called columnæ. To the extremities of theſe pillars are faſtened ſeveral tendinous cords, the other ends of which are joined to the valvulæ tricuſpides. There are likewiſe other ſmall ſhort tendinous ropes along both edges of the ſeptum between the ventricles. Theſe ſmall cords lie in an obliquely tranſverſe ſituation, and form a kind of net-work at different diſtances.

The cavities of the inner ſurface of the ventricles are ſmall deep foſſulæ or lacunæ placed very near each other, with ſmall prominent interſtices between them.

The

The fleshy or muscular fibres of which the heart is made up, are disposed in a very singular manner, especially those of the right or anterior ventricle, being either bent into arches or folded into angles.

The fibres which are folded into angles are longer than those which are only bent into arches. The middle of these arches, and the angles of the folds, are turned towards the apex of the heart, and the extremities of the fibres towards the basis. These fibres differ not only in length, but in their directions, which are very oblique in all, but much more so in the long or folded fibres than in the short ones, which are simply bent.

Each ventricle is composed of its proper distinct fibres, but the left ventricle has many more than the right. Where the two ventricles are joined, they form a septum which belongs equally to both.

The fibres which compose the inner or concave surface of the ventricles, do not all reach to the basis; some of them running into the cavity, and there forming the fleshy columnæ, to which the loose floating portion of the tricuspidal valves is fastened by tendinous ropes.

The valves at the orifices of the ventricles are of two kinds. One kind allows the blood to enter the heart, and hinders it from going out the same way; the other kind allows the blood to go out of the heart, but hinders it from returning. The valves of the first kind terminate the auriculæ, and those of the second lie in the openings of the great arteries. The first are termed semulanar or sigmoidal valves, the others triglochines, tricuspidal, or mitral.

The tricuspidal valves of the right ventricle are fixed to its auricular orifice, and turned inward toward the cavity of the ventricle. They are three triangular productions, very smooth and polished on that side which is turned towards the auricle; and on the side next the cavity of the ventricle, they have several membranous and tendinous expansions, and their edges are notched or indented. The valves of the auricular orifice of the left ventricle are of the same shape and structure, but they are only two in number; and from some small resemblance to a mitre, they have been named mitrales.

The semilunar valves are six in number, three belonging to each ventricle, situated at the mouths of the great arteries; and they may be properly enough named valvulæ arteriales.

The great artery that goes out from the left ventricle, is termed aorta. As it goes out, it turns a little toward the right hand, and then bends obliquely backward to form what is called aorta descendens.

The trunk of the artery which goes out from the right ventricle is called arteria pulmonaris. This trunk, as it is naturally situated in the thorax, runs first of all directly upward for a small space, then divides laterally into two principal branches, one for each lung; that which goes to the right lung being the longest, for a reason that shall be given hereafter.

The auricles are muscular bags situated at the basis of the heart, one towards the right ventricle, the other towards the left; and joined together by an inner septum, and external communicating fibres, much in the same manner with the ventricles; one of them being named the right auricle, the other the left. They are very uneven on the inside, but smoother on the outside, and terminate in a narrow, flat, indented edge, representing a cock's comb, or in some measure the ear of a dog. They open into these orifices of each ventricle, which are named auricular orifices; and they are tendinous at their opening, in the same manner as the ventricles.

The right auricle is larger than the left, and it joins the right ventricle by a common tendinous opening. It has two other openings united into one, and formed by two large veins which meet and terminate there, almost in a direct line, called vena cava superior and inferior. The notched edge of this auricle terminates obliquely in a kind of obtuse point, which is a small particular production of the great bag, and is turned toward the middle of the basis of the heart.

The left auricle is a kind of muscular bag or reservoir, of a pretty considerable thickness, and unequally square, into which the four veins open, called *venæ pulmonares*, and which has a distinct appendix belonging to it, like a third small auricle. This bag is very even on both sides.

The heart lies almost transversely on the diaphragm, the greatest part of it being in the left cavity of the thorax, and the apex being turned toward the bony extremity of the sixth true rib. The basis is toward the right cavity; and both auricles, especially the right, rest on the diaphragm.

The origin or basis of the pulmonary artery is, in this natural situation, the highest part of the heart on the foreside; and the trunk of this artery lies in a perpendicular plane, which may be conceived to pass between the sternum and spina dorsi. Therefore some part of the basis of the heart is in the right cavity of the thorax; and the rest, all the way to the apex, is in the left cavity; and it is for this reason that the mediastinum is turned toward that side.

According to this true natural situation of the heart, the parts commonly said to be on the right side are rather anterior, and those on the left side posterior; and that side of the heart which is thought to be the foreside, is naturally the upper side, and the backside consequently the lower side.

The lower side is very flat, lying wholly on the diaphragm; but the upper side is a little convex through its whole length, in the direction of the septum between the ventricles.

The heart, with all the parts belonging to it, is contained in a membranous capsula, called *pericardium*, which is in some measure of a conical figure, and much bigger than the heart. It is not fixed to the basis of the heart, but round the large veins above the auricles, before they send off the ramifications, and round the large arteries, before their divisions.

The pericardium is made up of three laminæ, the middle and chief of which is composed of very fine tendinous filaments, closely interwoven and crossing each other in different directions. The internal lamina seems to be a continuation of the outer coat of the heart, auricles, and great vessels. The trunks of the aorta and pulmonary artery have one common coat which contains them both as in a sheath, and is lined on the inside by a cellular substance, chiefly in that space which lies between

where

where the trunks are turned to each other, and the ſides of the ſheath. There is but a very ſmall portion of the vena cava contained in the pericardium.

The pericardium is cloſely connected to the diaphragm, not at the apex, but exactly at that place which anſwers to the flat or lower ſide of the heart; and it is a very difficult matter to ſeparate it from the diaphragm in diſſection.

The internal lamina is perforated by an infinite number of very ſmall holes, through which a ſerous fluid continually tranſudes, in the ſame manner as in the peritonæum. This fluid being gradually collected after death, makes what is called *aqua pericardii*, which is found in conſiderable quantities in opening dead bodies while they remain freſh. Sometimes it is of a reddiſh colour, which may be owing to a tranſudation of blood through the fine membrane of the auricles.

The heart and parts belonging to it are the principal inſtruments of the circulation of the blood. The two ventricles ought to be conſidered as two ſyringes ſo cloſely joined together as to make but one body, and furniſhed with ſuckers placed in contrary directions to each other, ſo as that by drawing one of them, a fluid is let in, and forced out again by the other.

The heart is made up of a ſubſtance capable of contraction and dilatation. When the fleſhy fibres of the ventricles are contracted, the two cavities are leſſened in an equal and direct manner, not by any contortion or twiſting, as the falſe reſemblance of the fibres to a figure of eight has made anatomiſts imagine. For if we conſider attentively in how many different directions, and in how many places, theſe fibres croſs each other, as has been already obſerved, we muſt ſee clearly, that the whole ſtructure tends to make an even, direct, and uniform contraction, more according to the breadth or thickneſs, than according to the length of the heart, becauſe the number of fibres ſituated tranſverſely, or almoſt tranſverſely, is much greater than the number of longitudinal fibres.

The fleſhy fibres thus contracted, do the office of ſuckers, by preſſing upon the blood contained in the ventricles, which blood being thus forced toward the baſis of the heart, preſſes the tricuſpidal valves againſt each other, opens the ſemilunares, and ruſhes with impetuoſity through the arteries and their ramifications, as through ſo many elaſtic tubes.

The blood thus puſhed on by the contraction of the ventricles, and afterwards preſſed by the elaſtic arteries, enters the capillary veſſels, and is from thence forced to return by the veins to the auricles, which, like retirements, porches, or antichambers, receive and lodge the blood returned by the veins during the time of a new contraction. This contraction of the heart is by anatomiſts termed *ſyſtole*.

The contraction or ſyſtole of the ventricles ceaſes immediately, by the relaxation of their fleſhy fibres; and in that time the auricles, which contain the venal blood, being contracted, force the blood through the tricuſpidal valves into the ventricles, the ſides of which are thereby dilated, and their cavities enlarged. This dilatation is termed *diaſtole*.

In this manner does the heart, by the alternate ſyſtole and diaſtole of its ventricles and auricles, puſh the blood through the arteries to all the parts of the body, and receive it again by the veins. This is called the circulation of the blood, which is carried on in three different manners.

The firſt and moſt univerſal kind of circulation is that by which almoſt all the arteries of the body are filled by the ſyſtole of the heart, and the greateſt part of the veins evacuated by the diaſtole.

The ſecond kind of circulation oppoſite to the firſt, is through the coronary veſſels of the heart, the arteries of which are filled with blood during the diaſtole of the ventricles, and the veins emptied during the ſyſtole.

The third kind of circulation is that of the left ventricle of the heart; through the venal ducts of which a ſmall quantity of blood paſſes, without going through the lungs, which is the courſe of all the remaining maſs of blood.

PULMONES.

The lungs are two large ſpungy bodies, of a reddiſh colour in children, greyiſh in adult ſubjects, and bluiſh in old age; filling the whole cavity of the thorax, one being ſeated in the right ſide, the other in the left, parted by the mediaſtinum and heart, and of a figure anſwering to that of the cavity which contains them; that is, convex next the ribs, concave next the diaphragm, and irregularly flatted and depreſſed next the mediaſtinum and heart.

They are diſtinguiſhed into the right and left lung; and each of theſe into two or three portions called *lobi*; of which the right lung has commonly three, or two and a half, and the left lung two. The right lung is generally larger than the left, anſwerably to that cavity of the breaſt, and the obliquity of the mediaſtinum.

At the lower edge of the left lung, there is an indented notch or ſinus oppoſite to the apex of the heart, which is therefore never covered by that lung, even in the ſtrongeſt inſpirations, and conſequently the apex of the heart and pericardium may always ſtrike againſt the ribs.

The ſubſtance of the lungs is almoſt all ſpungy, being made up of an infinite number of membranous cells, and of different ſorts of veſſels ſpread among the cells, in innumerable ramifications.

This whole maſs is covered by a membrane continued from each pleura, which is commonly ſaid to be double; but what is looked upon as the inner membrane is only an expanſion and continuation of a cellular ſubſtance.

The veſſels which compoſe part of the ſubſtance of the lungs are of three or four kinds; the air-veſſels, blood-veſſels, and lymphatics, and the nerves. The air-veſſels make the chief part, and are termed *bronchia*.

Theſe bronchia are conical tubes, compoſed of an infinite number of cartilaginous fragments, like ſo many irregular arches of circles, connected together by a ligamentary elaſtic membrane, and diſpoſed in ſuch a manner as that the lower eaſily inſinuate themſelves within thoſe above them.

They

They are lined on the infide by a very fine membrane, which continually difcharges a mucilaginous fluid; and in the fubftance of the membrane are a great number of fmall blood-veffels.

The bronchia are divided in all directions into an infinite number of ramifications, which diminifh gradually in fize; and as they become capillary, change their cartilaginous ftructure into that of a membrane.

Each of thefe numerous bronchial tubes is widened at the extremity, and thereby formed into a fmall membranous cell, commonly called a vesicle. Thefe cells or folliculi are clofely connected together in bundles; each fmall branch producing a bundle proportionable to its extent and the number of its ramifications.

Thefe fmall veficular or cellulous bundles are termed *lobules*; and as the great branches are divided into fmall rami, fo the great lobules are divided into feveral fmall ones. The cells or vesicles of each lobule have a free communication with each other, but the feveral lobules do not communicate fo readily.

The lobules appear diftinctly to be parted by another cellulous fubftance, which furrounds each of them in proportion to their extent, and fills up the interftices between them. This fubance forms likewife a kind of irregular membranous cells, which are thinner, loofer, and broader than the bronchial vesicles.

All the bronchial cells are furrounded by a very fine reticular texture of the fmall extremities of arteries and veins, which communicate every way with each other.

The blood-veffels of the lungs are of two kinds; one common, called the *pulmonary artery* and *veins*; the other proper, called the *bronchial arteries* and *veins*.

The pulmonary artery goes out from the right ventricle of the heart; and its trunk having run almoft directly upward as high as the curvature of the aorta, is divided into two lateral branches, one going to the right-hand, called the *right pulmonary artery*, the other to the left, termed the *left pulmonary artery*. The right artery paffes under the curvature of the aorta, and is confequently longer than the left. They both run to the lungs, and are difperfed through their whole fubftance by ramifications nearly like thofe of the bronchia, and lying in the fame directions.

The pulmonary veins having been diftributed through the lungs in the fame manner, go out on each fide, by two great branches, which open laterally into the refervoir or mufcular bag of the right auricle.

Befides thefe capital blood-veffels, there are two others called the *bronchial artery* and *vein*.

Under the root of each lung, that is, under that part formed by the fubordinate trunk of the pulmonary artery, by the trunks of the pulmonary veins, and by the trunk of the bronchia, there is a pretty broad membranous ligament, which ties the pofterior edge of each lung to the lateral parts of the vertebræ of the back, from that root all the way to the diaphragm.

The bronchia already defcribed are branches or ramifications of a large canal, partly cartilaginous, and partly membranous, called *trachea*, or *afpera arteria*. It is fituated anteriorly in the lower part of the neck, from whence it runs down into the thorax betwixt the two pleuræ, through the upper fpace left between the duplicature of the mediaftinum, behind the thymus.

Having reached as low as the curvature of the aorta, it divides into two lateral parts, one toward the right-hand, the other toward the left, which enter the lungs, and are diftributed through them in the manner already faid. Thefe two branches are called *bronchia*, and that on the right fide is fhorter than that of the left.

The trachea is made up of fegments of circles or cartilaginous hoops, difpofed in fuch a manner, as to form a canal open on the back part, the cartilages not going quite round; but this opening is filled by a foft glandular membrane, which completes the circumference of the canal.

Each circle is about the twelfth part of an inch in breadth, and about a quarter of that fpace in thicknefs. Their extremities are round; and they are fituated horizontally above each other, fmall interftices being left between them, and the lower edge of the fuperior fegments being turned toward the upper edge of thofe next below them.

They are all connected by a very ftrong elaftic membranous ligament fixed to their edges.

The canal of the afpera arteria is lined on the infide by a particular membrane, which appears to be partly flefhy or mufcular, and partly ligamentary, perforated by an infinite number of fmall holes, through which a mucilaginous fluid continually paffes, to defend the inner furface of the trachea againft the acrimony of the air.

This fluid comes from fmall glandular bodies difperfed through the fubftance of the membrane, but efpecially from the glands, fomething larger than the former, which lie on the outer or pofterior furface of that ftrong membrane, by which the circumference of the canal is completed. The fame ftructure is obfervable in the ramifications of the trachea from the greateft to the fmalleft.

At the angle of the firft ramification of the trachea arteria, we find on both the fore and back fides, certain foft, roundifh, glandular bodies, of a bluifh or blackifh colour, and of a texture partly like that of the thymus already defcribed, and partly like that of the glandula thyroides. There are other glands of the fame kind, as the origin of each ramification of the bronchia, but they decreafe proportionably in number and fize. They are fixed immediately to the bronchia, and covered by the interlobular fubftance; and they feem to communicate by fmall openings with the cavity of the bronchia.

Refpiration is performed by organs of two kinds, one of which may be looked upon as active, the other as paffive. The lungs are of the fecond kind, and the firft comprehends chiefly the diaphragm and intercoftal mufcles.

As foon as the intercoftal mufcles begin to contract, the arches of the ribs are raifed together with the fternum, and placed at a greater diftance from each other; by which means the cavity of the thorax is inlarged on the two lateral and anterior fides.

At the fame inftant the diaphragm is flatted or brought toward a plane by two motions, which are apparently contrary; that is, by the contraction of the diaphragm, and the dilatation of the ribs in which it is inferted. The external furface of the thorax being thus in a manner increafed, and the cavity of the bronchia being

being at the ſame time, and by the ſame means, leſs reſiſted or preſſed upon; the ambient air yields to the external preſſure, and inſinuates itſelf into all the places where the preſſure is diminiſhed, that is, into the aſpera arteria, and into all the ramifications of the bronchia all the way to the veſicles. This is what is called *inſpiration*.

This motion of inſpiration is inſtantaneous, and ceaſes in a moment by the relaxation of the intercoſtal muſcles; the elaſtic ligaments and cartilages of the ribs bringing them back at the ſame time to their former ſituation. This motion, by which the ribs are depreſſed and brought nearer each other, is termed *expiration*.

The pulmonary arteries and veins which accompany the bronchia through all their ramifications, and ſurround the veſicles, tranſmit the blood through their narrow capillary extremities, and thereby change or modify it, at leaſt in three different manners.

The firſt change or modification which the blood undergoes in the lungs, is to have the coheſions of its parts broken, to be attenuated, pounded, and, as it were, reduced to powder. The ſecond is, to be deprived of a certain quantity of ſerum, which tranſpires through the lungs, and is what we commonly call the *breath*. The third is to be in a manner reanimated by the impreſſion of the air.

OESOPHAGUS.

The œſophagus is a canal partly muſcular, and partly membranous, ſituated behind the trachea arteria, and before the vertebræ of the back, from near the middle of the neck, down to the lower part of the thorax; from whence it paſſes into the abdomen through a particular hole of the ſmall or inferior muſcle of the diaphragm, and ends at the upper orifice of the ſtomach.

It is made up of ſeveral coats, almoſt in the ſame manner as the ſtomach, of which it is the continuation. The firſt coat, while in the thorax, is formed only by the duplicature of the poſterior part of the mediaſtinum, and is wanting above the thorax and the neck, where the outer coat of the œſophagus is only a continuation of the cellular ſubſtance belonging to the neighbouring parts.

The ſecond coat is muſcular, being made up of ſeveral ſtrata of fleſhy fibres.

The third is termed the *nervous coat*, and is like that of the ſtomach and inteſtines.

The fourth or innermoſt coat reſembles in ſome meaſure that of the inteſtines, except that inſtead of the villi it has ſmall and very ſhort papillæ. Through the pores of this coat, a viſcid lympha is continually diſcharged.

The œſophagus from its very beginning, turns a little to the left hand, and naturally runs along the left extremities of the cartilages of the aſpera arteria. The thyroid gland, pharynx and larynx, ſhall be deſcribed in another place.

DUCTUS THORACICUS.

The thoracic duct is a thin tranſparent canal, which runs up from the receptaculum chyli, along the ſpina dorſi, between the vena azygos and aorta, as high as the fifth vertebra of the back, or higher. From thence it paſſes behind the aorta toward the left hand, and aſcends behind the left ſubclavian vein, where it terminates in ſome ſubjects by a kind of veſicula, in others by ſeveral branches united together, and opens into the backſide of the ſubclavian vein near the outſide of the internal jugular.

This canal is plentifully furniſhed with ſemilunar valves turned upward. Its opening into the ſubclavian vein in the human body, is, in the place of valves, covered by ſeveral pelliculæ, ſo diſpoſed as to permit the entrance of the chyle into the vein, and hinder the blood from running into the duct. It is ſometimes double, one lying on each ſide, and ſometimes it is accompanied by appendices called *pampiniformes*.

EXPLANATION OF PLATE XIX.

Figure 1. ſhews the contents of the thorax and abdomen, in ſitu.

1, Top of the trachea, or wind-pipe. 2 2, The internal jugular veins. 3 3, The ſubclavian veins. 4, The vena cava deſcendens. 5, The right auricle of the heart. 6, The right ventricle. 7, Part of the left ventricle. 8, The aorta aſcendens. 9, The pulmonary artery. 10, The right lung, part of which is cut off to ſhew the great blood-veſſels. 11, The left lung entire. 12 12, The anterior edge of the diaphragm. 13 13, The two great lobes of the liver. 14, The ligamentum rotundum. 15, The gall bladder. 16, The ſtomach. 17 17, The jejunum and ilium. 18, The ſpleen.

Fig. 2. Shews the organs ſubſervient to the chylopœtic viſcera, —with thoſe of urine and generation.

1 1, The under ſide of the two great lobes of the liver. 2, Lobulus Spigelii. 2, The ligamentum rotundum. 3, The gall-bladder. 4, The pancreas. 5, The ſpleen. 6 6, The kidneys. 7, The aorta deſcendens. 8, Vena cava aſcendens. 9 9, The renal veins covering the arteries. 10, A probe under the ſpermatic veſſels and a bit of the inferior meſenteric artery, and over the ureters. 11 11, The ureters. 12 12, The iliac arteries and veins. 13 The rectum inteſtinum. 14, The bladder of urine.

Fig. 3. Shews the chylopœtic viſcera, and organs ſubſervient to them, taken out of the body intire.

A A, The under ſide of the two great lobes of the liver. B, Ligamentum rotundum. C, The gall-bladder. D, Ductus cyſticus. E, Ductus hepaticus. F, Ductus communis choledochus. G, Vena portarum. H, Arteria hepatica. I I, The ſtomach. K K, Venæ & arteriæ gaſtro-epiploicæ, dextræ & ſiniſtræ. L L, Venæ & arteriæ coronariæ ventriculi, M, The ſpleen. N N, Meſocolon, with its veſſels. O O O, Inteſtinum

teſtinum colon. P, One of the ligaments of the colon, which is a bundle of longitudinal muſcular fibres. Q Q Q Q, Jejunum and ilium. R R, Sigmoid flexure of the colon with the ligament continued, and over S, The rectum inteſtinum. T T, Levatores ani. U, Sphincter ani. V, The place to which the proſtate gland is connected. W, The anus.

Fig. 4. Shews the heart of a fœtus at the full time, with the right auricle cut open to ſhew the foramen ovale, or paſſage between both auricles.

a, The right ventricle. b, The left ventricle. c c, The outer ſide of the right auricle ſtretched out. d d, The poſterior ſide, which forms the anterior ſide of the ſeptum. e, The foramen ovale, with the membrane or valve which covers the left ſide. f, Vena cava inferior paſſing through g, A portion of the diaphragm.

Fig. 5. Shews the heart and large veſſels of a fœtus at the full time.

a, The left ventricle, b, The right ventricle. c, A part of the right auricle. d, Left auricle. e e, The right branch of the pulmonary artery. f, Arteria pulmonalis. g g, The left branch of the pulmonary artery, with a number of its largeſt branches diſſected from the lungs. h, The canalis arterioſus. i, The arch of the aorta. k k, The aorta deſcendens. l, The left ſubclavian artery. m, The left carotid artery. n, The right carotid artery. o, The right ſubclavian artery. p, The origin of the right carotid and right ſubclavian arteries in one common trunk. q, The vena cava ſuperior or deſcendens. r, The right common ſubclavian vein. s, The left common ſubclavian vein.

N. B. All the parts deſcribed in this figure are to be found in the adult, except the canalis arterioſus.

EXPLANATION of PLATE XX.

Fig. 1. Repreſents the under and poſterior ſide of the bladder of urine, *&c.*

a, The bladder. b b, The inſertion of the ureters. c c, The vaſa deferentia, which convey the femen from the teſticles to d d, The veſiculæ ſeminales,—and paſs through e, The proſtate gland, to diſcharge themſelves into f, The beginning of the urethra.

Fig. 2. A tranſverſe ſection of the penis.

g g, Copora cavernoſa penis. h, Corpus cavernoſum urethræ. i, Urethra. k, Septum penis. l l, The ſeptum between the corpus cavernoſum urethræ, and that of the penis.

Fig. 3. A longitudinal ſection of the penis.

m m, The corpora cavernoſa penis, divided by o, The ſeptum penis. n, The corpus cavernoſum glandis, which is the continuation of that of the urethra.

Fig. 4. Repreſents the female organs of generation.

a, That ſide of the uterus which is next the os ſacrum. 1, Its fundus. 2, Its cervix. b b, The Fallopian or uterine tubes, which opens into the cavity of the uterus;—but the other end is open within the pelvis, and ſurrounded by c c, The fimbriæ. d d, The ovaria. e, The os internum uteri, or mouth of the womb. f f, The ligamenta rotunda, which paſſes without the belly, and is fixed to the labia pudendi. g g, The cut edges of the ligamenta lata, which connects the uterus to the pelvis. h, The inſide of the vagina. i, The orifice of the urethra. k, The clitoris ſurrounded by (l,) the præputium. m m, The labia pudendi. n n, The nymphæ.

Fig. 5. Shews the ſpermatic ducts of the teſticle filled with mercury.

A, The vas deferens. B, Its beginning, which forms the poſterior part of the epididymis. C, The middle of the epididymis, compoſed of ſerpentine ducts. D, The head or anterior part of the epididymis unravelled. e e e e, The whole ducts which compoſe the head of the epididymis unravelled. f f, The vaſa efferentia. g g, Rete teſtis. h h, Some rectilineal ducts which ſend off the vaſa efferentia. i i, The ſubſtance of the teſticle.

Fig. 6. The right teſticle intire, and the epididymis filled with mercury.

A, The beginning of the vas deferens. B, The vas deferens aſcending towards the abdomen. C, The poſterior part of the epididymis, named globus minor. D, The ſpermatic veſſels incloſed in cellular ſubſtance. E, The body of the epididymis. F, Its head, named globus major. G, Its beginning from the teſticle. H, The body of the teſticle, incloſed in the tunica albuginea.

Sect. IV. *Of the* Brain *and its Appendages.*

The name of brain is given to all that maſs which fills the cavity of the cranium, and which is immediately ſurrounded by two membranes called meninges or matres.

This general maſs is divided into three particular portions; the cerebrum or brain properly ſo called, the cerebellum, and medulla oblongata. To theſe three parts a fourth is added, which fills the great canal of the ſpina dorſi, by the name of medulla ſpinalis, being a continuation of the medulla oblongata.

The

The meninges or membranes are two in number. The first is named dura mater; the second pia mater, which is again divided into two; the external lamina being termed arachnoides, the internal retaining the common name of pia mater.

DURA MATER.

The dura mater incloses the brain and all it appendages. It lines the inside of the cranium, and supplies the place of an internal periosteum, being spread in all the holes and depressions, and covering all the eminences in such a manner as to prevent their being hurtful to the brain.

The dura mater is made up of two laminæ, adhering very closely together; the fibres of both crossing each other obliquely. Their texture is very close and strong, appearing to be partly ligamentary and partly tendinous.

The dura mater sticks closely to the cranium by a great number of filaments of the external lamina, which enter the pores of the bones chiefly at the sutures both above and below; and by penetrating these joints, they communicate with the external periosteum.

These adhesions are formed intirely by the external lamina. The internal lamina is very smooth and polished on the inside, which is also continually mostened by a fine fluid discharged through its pores, much in the same manner as in the peritonæum and pleura.

The folds of the dura mater are made by the internal lamina; and three of them form particular septa; one of which is superior, representing a kind of mediastinum between the two great lobes of the brain. The second is in a middle situation, like a diaphragm between the cerebrum and cerebellum; the third is inferior, between the lobes of the cerebellum. The superior septum is longitudinal, in form of a scythe, from whence it is termed the falx of the dura mater. The middle septum is transverse, and might be called the diaphragm of the brain. The inferior septum is very small, and runs down between the lobes of the cerebellum.

Besides these large folds, there are two small lateral ones on each side of the sella turcica, each running from the posterior to the anterior clynoid apophysis on the same side. These two folds, together with the anterior and posterior parts of the sella turcica, form a small fossula in which the pituitary gland is lodged.

The elongations of the dura mater are productions of both laminæ, which go beyond the general circumference, and pass out of the cranium.

The most considerable of these elongations passes through the great occipital foramen, and runs down the common canal of the vertebræ in form of a tube, lining the inside of that canal, and inclosing the medulla spinalis, by the name of the dura mater of that medulla. The other elongations accompany the nerves out of the cranium in form of vaginæ, which are more numerous than the nervous trunks reckoned in pairs.

There are two particular elongations which form the periosteum of the orbits, together with the vaginæ of the optic nerves. These orbitary elongations go out by the sphenoidal or superior orbitary fissures, and, increasing in breadth in their passage, line the whole cavity of the orbits, at the edges of which they communicate with the pericranium and periosteum of the face.

The elongations of the dura mater which accompany the blood-vessels through the foramina of the cranium, unite with the pericranium immediately afterwards. Such, for instance, are the elongations which line the fossulæ of the foramina lacera or jugularia, and the bony or carotid canals of the apophysis petrosa, *&c.*

The dura mater contains in its duplicature several particular canals, into which the venal blood not only of that membrane, but of the whole brain, is carried. These canals are termed sinuses, and some of them are disposed in pairs, others in uneven numbers; that is, some of them are placed alone, in a middle situation; others are disposed laterally on each side of the brain. The most ancient anatomists reckoned only four; to which we can now add four times as many.

These sinuses are in the duplicature of the dura mater; and their cavities are lined on the inside by particular very fine membranes. They may be enumerated in this manner.

The great sinus of the falx, or superior longitudinal sinus, which was reckoned the first by the ancients.

Two great lateral sinuses, the second and third of the ancients.

The sinus called *torcular Herophili*, the fourth of the ancients.

The small sinus of the falx, or inferior longitudinal sinus.

The posterior occipital sinus, which is sometimes double.

Two inferior occipital sinuses, which form a portion of a circle, and may likewise be called the *inferior lateral sinuses*.

Six sinus petrosi, three on each side, one anterior, one middle or angular, and one inferior. The two inferior, together with the occipital sinuses, complete a circular sinus round the great foramen of the os occipitis.

The inferior transverse sinus.

The superior transverse sinus.

The two circular sinuses of the sella sphenoidalis; one superior, and one inferior.

Two sinus cavernosi, one on each side.

Two orbitary sinuses, one on each side.

All these sinuses communicate with each other, and with the great lateral sinuses by which they discharge themselves into the internal jugular veins, which are only continuations of these lateral sinuses. They likewise unload themselves partly into the vertebral veins, which communicate with the small lateral or inferior occipital sinuses; and partly into the external jugular veins, by the orbitary sinuses which communicate with the venæ angulares, frontales, nasales, maxillares, &c. as the lateral sinuses likewise communicate with the venæ occipitales, &c.

Thus the blood which is carried to the dura mater, &c. by the external and internal carotid, and by the vertebral arteries, is returned to the heart by the external and internal jugular and vertebral veins; so that when the passage of the blood is obstructed in any particular place, it finds another way, by virtue of these communications, though not with the same ease.

Plate XX.

A. Bell Sculp.

PIA MATER.

This membrane ſurrounds the whole maſs of the brain more particularly than the dura mater. It adheres very cloſely to the brain, and is connected to the dura mater only by the veins which open into the ſinuſes.

The pia mater is made up of two very fine laminæ, the outermoſt of which covers pretty uniformly all the convex ſurface of the brain, and lines in the ſame manner all the concave or inner ſurface of the dura mater. The internal lamina forms a great number of plicæ, duplicatures, and ſepta, which inſinuate themſelves into all the folds and circumvolutions, and between the different ſtrata of the cerebrum and cerebellum.

CEREBRUM.

The cerebrum properly ſo called, is a kind of medullary maſs, of a moderate conſiſtence, and of a greyiſh colour on the outer ſurface, filling all the ſuperior portion of the cavity of the cranium, or that portion which lies above the tranſverſe ſeptum. The upper part of the cerebrum is of an oval figure, like half an egg cut lengthwiſe. It is flatted on the lower part, each lateral half of which is divided into three eminences, called lobes, one anterior, one middle, and one poſterior.

The ſubſtance of the cerebrum is of two kinds, diſtinguiſhed by two different colours; one part of it, which is ſofteſt, being of a greyiſh or aſh colour; the other, which is more ſolid, being very white. The aſh-coloured ſubſtance lies chiefly on the outer part of the cerebrum like a kind of cortex, from whence it has been named *ſubſtantia corticalis* or *cinerea*. The white ſubſtance occupies the inner part, and is named *ſubſtantia medullaris*, or ſimply *ſubſtantia alba*.

The cerebrum is divided into two lateral portions, ſeparated by the falx, or great longitudinal ſeptum of the dura mater. They are generally termed hemiſpheres. Each of theſe portions is divided into two extremities, one anterior and one poſterior, which are termed the lobes of the cerebrum, between which there is a large inferior protuberance which goes by the ſame name; ſo that in each hemiſphere there are three lobes, one anterior, one middle, and one poſterior.

The anterior lie upon theſe parts of the os frontis which contribute to the formation of the orbits and of the frontal ſinuſes, commonly called the anterior foſſæ of the baſis cranii. The poſterior lobes lie on the tranſverſe ſeptum; and the middle lobes, in the middle or lateral foſſæ of the baſis cranii.

Each lateral portion of the cerebrum has three ſides; one ſuperior, which is convex; one inferior, which is uneven; and one lateral, which is flat, and turned to the falx. Through the whole ſurface of theſe three ſides we ſee inequalities or windings like the circumvolutions of inteſtines, formed by waving ſtreaks or furrows very deep and narrow, into which the ſepta or duplicatures of the pia mater inſinuate themſelves, and thereby ſeparate theſe circumvolutions from each other.

Near the ſurface theſe circumvolutions are at ſome diſtance from each other, repreſenting ſerpentine ridges; and in the interſtices between them, the ſuperficial veins of the cerebrum are lodged, between the two laminæ of the pia mater, from whence they paſs in the duplicature of the dura mater, and ſo open into the ſinuſes.

Theſe circumvolutions are fixed through their whole depth to the ſepta or duplicatures of the pia mater, by an infinite number of very fine vaſcular filaments,

When they are cut tranſverſely, we obſerve that the ſubſtantia alba lies in the middle of each circumvolution, ſo that there is the ſame number of internal medullary circumvolutions as of external cortical ones.

Having cut off the falx from the criſta galli, and turned it backward; if we ſeparate gently the two lateral parts or hemiſpheres of the cerebrum, we ſee a longitudinal portion of a white convex body, which is named corpus calloſum. It is a middle portion of the medullary ſubſtance, which under the inferior ſinus of the falx, and alſo a little toward each ſide, is parted from the maſs of the cerebrum, to which it is ſimply contiguous from one end of that ſinus to the other.

The ſurface of the corpus calloſum is covered by the pia mater, which runs in between the lateral portions of this body, and the lower edge of each hemiſphere.

The corpus calloſum becomes afterwards continuous on each ſide with the medullary ſubſtance, which through all the remaining parts of its extent is intirely united with the cortical ſubſtance, and together with the corpus calloſum forms a medullary arch or vault of an oblong or oval figure. After which we will obſerve a medullary convexity much ſmaller than that which is common to the whole cerebrum, but of the ſame form; ſo that it appears like a medullary nucleus of the cerebrum.

Under this arch are two lateral cavities, much longer than they are broad, and very ſhallow, ſeparated by a tranſparent medullary ſeptum. Theſe cavities are named the anterior, ſuperior, or great lateral ventricles of the cerebrum.

The lateral ventricles are broad, and rounded at theſe extremities which lie next the tranſparent ſeptum. They go from before backward, contracting in breadth, and ſeparating from each other gradually in their progreſs. Afterwards they bend downward, and return obliquely from behind forward, in a courſe like the turning of a ram's horn, and terminate almoſt under their ſuperior extremities. Theſe ventricles are lined with a thin membrane.

The tranſparent partition or ſeptum lucidum, lies directly under the raphe or ſuture of the corpus calloſum, of which it is a continuation. It is made up of two medullary laminæ, more or leſs ſeparated from each other by a narrow medullary cavity, ſometimes filled with a ſerous ſubſtance.

The ſeptum lucidum is united by its lower part, to the anterior portion of that medullary body, called the *fornix with three pillars*.

The fornix being cut off and inverted, or quite removed, we ſee firſt of all a vaſcular web, called *plexus choroides*, and ſeveral eminences more or leſs covered by the expanſion of that plexus. There are four pairs of eminences

eminences which follow each other very regularly, two large, and two ſmall. The firſt two great eminences are named *corpora ſtriata*; and the ſecond, *thalami nervorum opticorum*. The four ſmall eminences are cloſely united together; the anterior being called *nates*, and the poſterior *teſtes*. Immediately before theſe tubercles there is a ſingle eminence, called *glandula pinealis*.

The *corpora ſtriata* got that name, becauſe in ſcraping them with the knife we meet with a great number of white and aſh-coloured lines alternately diſpoſed, which are only the tranſverſe ſection of the medullary and cortical laminæ, mixed together in a vertical poſition in the baſis of the cerebrum.

They lie in the bottom of the ſuperior cavity of the lateral ventricles, which they reſemble in ſome meaſure in ſhape, their anterior parts being near the ſeptum lucidum, from which they ſeparate gradually as they run backward, and diminiſh in ſize.

The *thalami nervorum opticorum* are ſo named, becauſe theſe nerves ariſe chiefly from them. They are two large eminences placed by the ſide of each other, between the poſterior portions or extremities of the copora ſtriata. Their figure is ſemi-ſpheroidal and a little oval; and they are of a whitiſh colour on the ſurface; but their inner ſubſtance is partly greyiſh and partly white.

Theſe two eminences are cloſely joined together, and at their convex part they are ſo far united as really to become one body, the whitiſh outer ſubſtance being continued uniformly over them both.

Immediately within this whitiſh common ſubſtance theſe two eminences are cloſely contiguous till about the middle of their thickneſs; and from thence they ſeparate inſenſibly toward the bottom, where by the ſpace left between them a particular canal is formed, named the third ventricle, one extremity of which opens forward, the other backward.

At the bottom theſe two eminences are elongated downward toward both ſides, into two thick, round, whitiſh cords, which ſeparate from each other like horns, by a large curvature; and afterwards by a ſmall curvature turned forward in an oppoſite direction to the former, and repreſenting the tip of an horn, they approach each other again. The ſize of theſe ropes diminiſhes gradually from their origin to their anterior reunion.

The tubercles are four in number, two anterior, and two poſterior; adhering together as if they made but one body, ſituated behind the union of the thalami nervorum opticorum. Their ſurface is white, and their inner ſubſtance greyiſh, and are called *nates* and *teſtes*.

Directly under the place where the tubercles of one ſide are united to thoſe of the other ſide, lies a ſmall middle canal, which communicates by its anterior opening with the third ventricle, under the thalami nervorum opticorum, and by its poſterior opening with the fourth ventricle, which belongs to the cerebellum.

Where the convex parts of the two anterior tubercles join theſe poſterior convex parts of the thalami nervorum opticorum, an interſtice or opening is left between theſe four convexities which communicates with the third ventricle, and with the ſmall middle canal. Inſtead of the ridiculous name of *anus*, which has been given to this opening, it may be called *foramen commune poſterius*.

The glandula pinealis is a ſmall ſoft greyiſh body, about the ſize of an ordinary pea, irregularly round, and ſometimes of the figure of a pine apple, ſituated behind the thalami nervorum opticorum, above the tubercula quadrigemina. It is fixed like a ſmall button to the lower part of the thalami by two very white medullary pedunculi, which at the gland are very near each other, but ſeparate almoſt tranſverſely toward the thalami.

It ſeems to be moſtly of a cortical ſubſtance, except near the footſtalks, where it is ſomething medullary.

Between the baſis of the anterior pillar of the fornix, and the anterior part of the union of the optic thalami, lies a cavity or foſſula named *infundibulum*. It runs down towards the baſis of the cerebrum, contracting gradually, and terminates in a ſtreight courſe, by a ſmall membranous canal, in a ſoftiſh body ſituated in the ſella turcica, named *glandula pituitaria*. The infundibulum opens above, immediately before the optic thalami, by an oval hole named *foramen commune anterius*, and conſequently communicates with the lateral ventricles.

At the lower part of the thalami nervorum opticorum, directly under their union, lies a particular canal, called the *third ventricle* of the cerebrum.

This canal opens forward into the infundibulum under the foramen commune anterius, by which it likewiſe communicates with the lateral ventricles. It opens backward under the foramen commune poſterius, between the thalami and tubercula quadrigemina, oppoſite to the ſmall middle canal which goes to the cerebellum.

The plexus choroides is a very fine vaſcular texture, conſiſting of a great number of arterial and venal ramifications, partly collected in two looſe faſciculi, which lie one in each lateral ventricle, and partly expanded over the neighbouring parts, and covering in a particular manner the thalami nervorum opticorum, glandula pinealis, tubercula quadrigemina, and the other adjacent parts both of the cerebrum and cerebellum, to all which it adheres.

The pituitary gland is a ſmall ſpongy body lodged in the ſella turcica between the ſphenoidal folds of the dura mater. It is of a ſingular kind of ſubſtance, which ſeems to be neither medullary nor glandular. On the outſide it is partly greyiſh and partly reddiſh, and white within. It is tranſverſely oval or oblong, and on the lower part in ſome ſubjects it is divided by a ſmall notch into two lobes, like a kidney-bean. It is covered by the pia mater as by a bag, the opening of which is the extremity of the infundibulum, and it is ſurrounded by the ſmall circular ſinuſes which communicate with the ſinus cavernoſi.

CEREBELLUM.

The cerebellum is contained under the tranſverſe ſeptum of the dura mater. It is broader laterally than on the fore or back ſides, flatted on the upper ſide, and gently inclined both ways, anſwerable to the ſeptum, which ſerves it as a kind of tent or cieling. On the lower ſide it is rounder; and on the backſide it is divided

into

into two lobes, ſeparated by the occipital ſeptum of the dura mater.

It is made up, like the cerebrum, of two ſubſtances, but it has no circumvolutions on its ſurface. Its ſulci are pretty deep, and diſpoſed in ſuch a manner as to form thin flat ſtrata, more or leſs horizontal, between which the internal lamina of the pia mater inſinuates itſelf by a number of ſepta equal to that of the ſtrata.

Under the tranſverſe ſeptum, it is covered by a vaſcular texture, which communicates with the plexus choroides. It has two middle eminences called *appendices vermiformes*; one anterior and ſuperior, which is turned forward; the other poſterior and inferior, which goes backward. There are likewiſe two lateral appendices, both turned outward.

Beſides the diviſion of the cerebellum into lateral portions or into two lobes, each of theſe lobes ſeems to be likewiſe ſubdivided into three protuberances, one anterior, one middle or lateral, and one poſterior.

When we ſeparate the two lateral portions or lobes, having firſt made a pretty deep inciſion, we diſcover firſt of all the poſterior portion of the medulla oblongata; and in the poſterior ſurface of this portion, from the tubercula quadrigemina, all the way to the poſterior notch in the body of the cerebellum, and a little below that notch, we obſerve an oblong cavity which terminates backward like the point of a writing pen. This cavity is what is called the fourth ventricle.

At the beginning of this cavity, immediately behind the ſmall common canal which lies under the tubercles, we meet with a thin medullary lamina, which is looked upon as a valve between that canal and the fourth ventricle. A little behind this lamina, the cavity grows wider towards both hands, and then contracts again to its firſt ſize. It is lined interiorly by a thin membrane, and ſeems oftentimes to be diſtinguiſhed into two lateral parts, by a kind of ſmall groove, from the valvular lamina to the point of the calamus ſcriptorius.

This membrane is a continuation of that which lines the ſmall canal, the third ventricle, infundibulum, and the two great ventricles.

On each ſide of this ventricle the medullary ſubſtance forms a trunk which expands itſelf in form of laminæ through the cortical ſtrata. When one lobe of the cerebellum is cut vertically from above downward, the medullary ſubſtance will appear to be diſperſed in ramifications through the cortical ſubſtance. Theſe ramifications have been named *arbor vitæ*; and the two trunks from whence theſe different laminæ ariſe, are called *pedunculi cerebelli*.

MEDULLA OBLONGATA.

The medulla oblongata is a medullary ſubſtance ſituated from before backward in the middle part of the baſes of the cerebrum and cerebellum without any diſcontinuation, between the lateral parts of both theſe baſes; and therefore it may be looked upon as one middle medullary baſis common to both cerebrum and cerebellum, by the reciprocal continuity of their medullary ſubſtances, through the great notch in the tranſverſe ſeptum of the dura mater; which common baſis lies immediately on that portion of the dura mater which lines the baſis of the cranium. The medulla oblongata is therefore juſtly eſteemed to be a third general part of the whole maſs of the brain, or as the common production or united elongation of the whole medullary ſubſtance of the cerebrum and cerebellum.

It is extremely difficult, if not altogether impoſſible, to examine or demonſtrate it as we ought, in its natural ſituation; but we are obliged to do both on a brain inverted.

The lower ſide of the medulla oblongata in an inverted ſituation, preſents to our view ſeveral parts which are in general either medullary productions, trunks of nerves, or trunks of blood-veſſels.

The chief medullary productions are theſe: The large or anterior branches of the medulla oblongata; which have likewiſe been named crura anteriora, femora, and brachia medullæ oblongatæ, and pedunculi cerebri: The tranſverſe protuberance, called likewiſe proceſſus annularis, or pons varolii: The ſmall or poſterior branches, called pedunculi cerebelli, or crura poſteriora medullæ oblongatæ: The extremity or cauda of the medulla oblongata, with two pairs of tubercles, one of which is named corpora olivaria, the other corpora pyramidalia; and to all theſe productions we muſt add a production of the infundibulum and two medullary papillæ.

The great branches of the medulla oblongata are two very conſiderable medullary faſciculi, the anterior extremities of which are ſeparated, and the poſterior united, ſo that, taken both together, they repreſent a Roman V.

The tranſverſe, annular, or rather ſemi-annular protuberance, is a medullary production, which ſeems at firſt ſight to ſurround the poſterior extremities of the great branches; but the medullary ſubſtance of this protuberance is in reality intimately mixed with that of the two former. Varolius, an ancient Italian author, viewing thoſe parts in an inverted ſituation, compared the two branches to two rivers, and the protuberance to a bridge over them both, and from thence it has the name of *pons Varolii*.

The ſmall branches of the medulla oblongata are lateral productions of the tranſverſe protuberance, which by their roots ſeem to encompaſs that medullary portion in which the fourth ventricle or calamus ſcriptorius is formed.

The extremity is no more than the medulla oblongata contracted in its paſſage backward to the anterior edge of the great foramen of the os occipitis, where it terminates in the medulla ſpinalis; and in this part of it ſeveral things are to be taken notice of. We ſee firſt of all, four eminences, two named *corpora olivaria*, and the other two *corpora pyramidalia*. Immediately afterwards, it is divided into two lateral portions by two narrow grooves, one on the upper ſide, the other on the lower. They both run into the ſubſtance of the medulla, as between two cylinders, flatted on that ſide by which they are joined together.

When we ſeparate theſe ridges with the fingers, we obſerve a crucial intertexture of ſeveral ſmall medullary cords,

cords, which go obliquely from the ſubſtance of one lateral portion into the ſubſtance of the other.

The corpora olivaria and pyramidalia are whitiſh eminences ſituated longitudinally near each other on the lower ſide of the extremity or cauda, immediately behind the tranſverſe or annular protuberances. The corpora olivaria are in the middle, ſo that the interſtice between them, which is a kind of ſuperficial groove, anſwers to the inferior groove of the following portion.

The corpora pyramidalia are two lateral eminences depending on the olivaria. Theſe four eminences are ſituated on the lower half of the medulla.

The tubercula mammillaria, or papillæ medullares, which are ſituated very near the production of the infundibulum, have been taken for glands.

Theſe tubercles ſeem to have ſome immediate relation to the roots or baſes of the anterior pillar of the fornix.

The beak or tube of the infundibulum is a very thin production from the ſides of that cavity; and it is ſtrengthened by a particular coat given to it by the pia mater. It is bent a little from behind forward, toward the glandula pinealis, and afterwards expands again round this gland.

The membrana arachnoides, or external lamina of the pia mater, appears to be very diſtinctly ſeparated from the internal lamina, in the interſtices between all theſe eminences on the lower ſide of the medulla oblongata, without any viſible cellular ſubſtance between them.

From this medulla oblongata, ariſe almoſt all the nerves which go out of the cranium through the different foramina by which its baſis is perforated. It likewiſe produces the medulla ſpinalis, which is no more than a common elongation of the cerebrum and cerebellum, and of their different ſubſtances; and therefore the medulla oblongata may juſtly be ſaid to be the firſt origin or primitive ſource of all the nerves of the human body.

MEDULLA SPINALIS.

The medulla ſpinalis is only an elongation of the extremity of the medulla oblongata; and it has its name from its being contained in the bony canal of the ſpina dorſi; conſequently a continuation or common appendix of the cerebrum or cerebellum, as well becauſe of the two ſubſtances of which it is compoſed, as becauſe of the membranes by which it is inveſted.

The dura mater, after it has lined the whole internal ſurface of the cranium, goes out by the great occipital foramen, and forms a kind of funnel, in its progreſs downward through the bony canal of the vertebræ.

The ſpinal marrow is made up of a cortical and medullary ſubſtance, as the cerebrum and cerebellum; but with this difference, that the aſh-coloured ſubſtance lies within the other; and in a tranſverſe ſection of this medulla, the inner ſubſtance appears to be of the figure of an horſe-ſhoe.

The body of the medulla ſpinalis runs down all the way to the firſt vertebra of the loins, where it terminates in a point. The ſize of it is proportionable to that of the bony canal, ſo that it is larger in the vertebræ of the neck than thoſe of the back.

It ſends off from both the fore and back ſides, at different diſtances, flat faſciculi of nervous filaments. The anterior and poſterior faſciculi having got a little beyond the edge of the medulla, unite in pairs, and form on each ſide a kind of knots, called *ganglions* by anatomiſts, each of which produces a nervous trunk. Theſe ganglions are made up of a mixture of cortical and medullary ſubſtance, accompanied by a great number of ſmall blood-veſſels.

The dura mater, which inveſts the medulla, ſends out on each ſide the ſame number of vaginæ as there are ganglions and nervous trunks. Theſe vaginæ are productions of the external lamina; the internal lamina, which is very ſmooth and poliſhed on the inſide, being perforated by two ſmall holes very near each other, where each vagina goes off, through which holes the extremities of each anterior and poſterior faſciculus are tranſmitted; and immediately after their paſſage through the internal lamina, they unite.

Uses *of the* Brain *and its Appendages in general.*

Malphighi was the firſt who diſcovered the brain to be a gland, or an organ fitted to ſeparate ſome particular fluid from the maſs of blood.

The infinite number of ſmall ſecretory cluſters ſtrain or filter the maſs of blood carried to them by the numerous ramifications, and ſeparate from it an exceſſively fine fluid; the remaining blood being conveyed back by the ſame number of venal extremities, into the ſinuſes of the dura mater, and from thence into the jugular and vertebral veins.

This ſubtile fluid, commonly called *animal ſpirit, nervous juice*, or *liquor of the nerves*, is continually forced into the medullary fibres of the white portion of the cerebrum, cerebellum, medulla oblongata, and medulla ſpinalis; and by the intervention of theſe fibres ſupplies and fills the nerves, which are a continuation of them.

PERICRANIUM.

Besides the external integuments of the head, the ſkin, hair, and cellular ſubſtance, there is an aponeurotic expanſion which covers the head like a cap, and is ſpread round the neck and on the ſhoulders like a riding-hood.

This aponeuroſis is very ſtrong on the head, and it appears to be made up at leaſt of two ſtrata of fibres croſſing each other. As it is ſpread on the neck it becomes gradually thinner, and ends inſenſibly on the clavicles. It ſends out a production on each ſide, from above downward, and from without inward, which having paſſed over the ſuperior extremity of the muſculus ſterno-maſtoidæus, runs behind that muſcle toward the tranſverſe apophyſes of the vertebræ of the neck, where it communicates with the ligamenta inter-tranſverſalia.

The external ſurface of all the bones of the head, as well

Plate XXI.

A. Bell Sculpt.

well as of all the other bones of the human body, except the teeth, is covered by a particular membrane, of which that portion which particularly invefts the cranium is named *pericranium*, and that which invefts the bones of the face is fimply termed *periofteum*.

The pericranium is made up of two laminæ clofely united together. The internal lamina, which has by fome been taken for a particular periofteum, covers immediately all the bony parts of this region; and the external lamina has been looked upon as a membrane diftinct from the internal, and named *pericranium* particularly.

SECT. V. *Of the* EYE.

The GLOBE *or* BALL *of the* EYE.

THE globe of the eye is made up of feveral proper parts, fome of which being more or lefs folid, reprefent a kind of fhell formed by the union of feveral membranous ftrata called the *coats* of the globe of the eye; and the other parts being more or lefs fluid, and contained in particular membranous capfulæ, or in the interftices between the coats, are termed the *humours* of the globe of the eye. Thefe capfulæ are likewife termed *coats*.

The coats of the globe of the eye are of three kinds. Some form chiefly the fhell of the globe; fome are additional, being fixed only to a part of the globe; and fome are capfular, which contain the humours. The coats which form the fhell are three in number. The external is termed *tunica fclerotica* or *cornea*; the middle coat is named *choroides*; and the third or innermoft, *retina*. The additional coats are two; one called *tendinofa* or *albuginea*, which forms the white of the eye; and the other, *conjunctiva*. The capfular tunicæ are likewife two, the vitrea, and cryftallina.

The COATS *of the* EYE.

THE moft external, thickeft, and ftrongeft coat of the eye is the fclerotica or cornea, and it invefts all the other parts of which the globe is compofed. It is divided into two portions, one called *cornea opaca*, the other *cornea lucida*, which is only a fmall fegment of a fphere, fituated anteriorly.

The cornea opaca is made up of feveral ftrata clofely connected together, and is of an hard compact texture refembling parchment. About the middle of its pofterior convex portion, where it fuftains the optic nerve, it is in a manner perforated, and thicker than any where elfe.

The cornea lucida is made up in the like manner of feveral ftrata or laminæ clofely united, and appears to be a continuation of the opaque portion or fclerotica, though of a different texture.

This portion is fomething more convex than the cornea opaca, fo that it reprefents the fegment of a fmall fphere added to the fegment of a greater.

The cornea lucida is perforated by a great number of imperceptible pores, through which a very fine fluid is continually difcharged, which foon afterwards evaporates.

The fecond coat of the globe of the eye is the choroides, which is of a blackifh colour, more or lefs inclined to red, and adheres, by means of a great number of fmall veffels, to the cornea opaca, from the infertion of the optic nerve, all the way to the union of the two corneæ, where it leaves the circumference of the globe, and forms a perforated feptum, by which the fmall fegment of the globe is feparated from the greater. This portion goes commonly by the particular name of *uvea*, which was formerly given to the whole fecond coat; and as it is of different colours in feveral fubjects, it has likewife got the name of *iris*.

The anterior portion or perforated feptum of the choroides has the name of *uvea*, and the hole near the centre of this feptum is called *pupilla*. The anterior lamina of the fame feptum is termed *iris*, and the radiated plicæ of the pofterior lamina, *proceffus ciliares*. Between the two laminæ of the uvea, we find two very thin planes of fibres which appear to be flefhy, the fibres of one plane being orbicular, and lying round the circumference of the pupilla, and thofe of the other being radiated, one extremity of which is fixed to the orbicular plane, the other to the great edge of the uvea.

The plicæ or proceffus ciliares are fmall radiated and prominent duplicatures of the pofterior lamina of the uvea, and their circumference anfwers partly to that of the white ring of the external lamina. They are oblong thin plates; their pofterior extremities, or thofe next the choroides, being very fine and pointed; the others, or thofe next the pupilla, broad, prominent, and ending in acute angles.

The fpace between the cornea lucida and uvea contains the greateft part of the aqueous humour, and communicates by the pupilla with a very narrow fpace behind the uvea, or between that and the cryftalline. Thefe two fpaces have been termed the two chambers of the aqueous humour, one anterior, the other pofterior.

The third coat of the eye is of a very different texture from that of the other two coats. It is white, foft, and tender, and in a manner medullary, or like a kind of pafte fpread upon a fine reticular web. It appears to be thicker than the choroides, and reaches from the infertion of the optic nerve, to the extremities of the ciliary radii, being equally fixed to the choroides through its whole extent. At the place which anfwers to the infertion of the optic nerve, we obferve a fmall depreffion, in which lies a fort of medullary button terminating in a point; and from this depreffion blood-veffels go out, which are ramified on all fides through the fubftance of the retina.

The HUMOURS *of the* EYE *and their* CAPSULÆ.

The vitreous humour is a clear and very liquid gelatinous fluid, contained in a fine tranfparent capfula, called *tunica vitrea*, together with which it forms a mafs nearly of the confiftence of the white of an egg. It fills the greateft part of the globe of the eye, that is, almoft all that fpace which anfwers to the extent of the retina, except a fmall portion behind the uvea, where it forms a foffula, in which the cryftalline is lodged.

The tunica vitrea is compofed exteriorly of two laminæ

are very closely connected, which quite surround the mass of humour, and are immediately applied to the retina, all the way to the great circumference of the corona ciliaris; but from thence to the circular edge of the fossula of the crystalline, this coat is full of radiated sulci, which contain the processus ciliares of the uvea.

The internal lamina of the tunica vitrea gives off, through the whole substance of this humour, a great number of cellular elongations or septa.

The radiated sulci of the tunica vitrea, which may be termed *sulci ciliares*, are perfectly black, when the coat is taken out of the body.

The crystalline is a small lenticular body, of a pretty firm consistence, and transparent like crystal. It is contained in a transparent membranous capsula, and lodged in the anterior fossula of the vitreous humour.

The figure of the crystalline is lenticular, but its posterior side is more convex than the anterior, the convexity of both sides being very rarely equal.

The crystalline capsula or coat is formed by a duplicature of the tunica vitrea The external lamina covers the anterior side of the crystalline mass; the internal lamina covers the backside, and likewise the fossula vitrea, in which the crystalline is lodged.

The anterior portion swells when macerated in water, and then appears to be made up of two pelliculæ, united by a fine spungy substance.

The aqueous humour is a very limpid fluid, resembling a kind of lympha or serum, with a very small degree of viscidity; and it has no particular capsula like the crystalline and vitreous humours. It fills the space between the cornea lucida and uvea, that between the uvea and the crystalline, and the hole of the pupilla. These two spaces are called the chambers of the aqueous humour, and they are distinguished into the anterior and posterior.

The anterior chamber, which is visible to every body, between the cornea lucida and uvea, is the largest; the other between the uvea and crystalline is very narrow, especially near the pupilla, where the uvea almost touches the crystalline.

The Tunica Albuginea *and* Muscles *of the* Globe *of the* Eye.

The tunica albuginea, called commonly the *white* of the eye, and which appears on all the anterior convex side of the globe, from the cornea lucida, to the beginning of the posterior side, is formed chiefly by the tendinous expansion of four muscles.

There are commonly six muscles inserted in the globe of the human eye, and they are divided into four recti and two obliqui. The recti are again divided, from their situation, into superior, inferior, internal, and external; and from their functions, into a levator, depressor, adductor, and abductor. The two oblique muscles are denominated from their situation and size, one being named *obliquus superior* or *major*, the other *obliquus inferior*, or *minor*. The obliquus major is likewise called *trochlearis*, because it passes through a small cartilaginous ring, as over a trochlea or pulley.

The musculi recti are fixed by their posterior extremities at the bottom of the orbit near the foramen opticum in the elongation of the dura mater, by short narrow tendons. From thence they run wholly fleshy, toward the great circumference of the convexity of the globe, between the optic nerve and cornea lucida, where they are expanded into flat broad tendons which touch each other, and afterwards unite. These tendons are fixed first of all by a particular insertion in the circumference just mentioned, and afterwards continue their adhesion all the way to the cornea, forming the tunica albuginea.

The superior oblique muscle is fixed to the bottom of the orbit, by a narrow tendon, in the same manner as the recti, between the rectus superior and internus. From thence it runs on the orbit opposite to the interstice between these two muscles, toward the internal angular apophysis of the os frontis, where it terminates in a thin tendon, which having passed through a kind of ring as over a pulley, runs afterwards in a vagina obliquely backward under the rectus superior, that is between that muscle and the globe; and, increasing in breadth, it is inserted posteriorly and laterally in the globe, near the rectus externus.

The ring through which this muscle passes, is partly cartilaginous and partly ligamentary. The cartilaginous portion is flat, of a considerable breadth, and like half a ring. The ligamentary portion adheres strongly to the two ends of the cartilage, and is fixed in the small fossula which lies in the orbit, on the angular apophysis of the os frontis. By means of this ligament, the ring is in some measure moveable, and yields to the motions of the muscle. To the anterior edge of the ring, a ligamentary vagina is fixed, which invests the tendon all the way to its insertion in the globe.

The obliquus inferior is situated obliquely at the lower side of the orbit, under the rectus inferior, which consequently lies between this muscle and the globe. It is fixed by one extremity a little tendinous, to the root of the nasal apophysis of the os maxillare, near the edge of the orbit between the opening of the ductus nasalis, and the inferior orbitary fissure.

From thence it passes obliquely, and a little transversely backward, under the rectus inferior, and is fixed in the posterior lateral part of the globe by a flat tendon, opposite to, and at a small distance from the tendon of the obliquus superior, so that these two muscles do in some measure surround the outer posterior part of the globe.

The rectus superior moves the anterior portion of the globe upward when we lift up the eyes; the rectus inferior carries this portion downward; the internus, toward the nose; and the externus, toward the temples.

When two neighbouring recti act at the same time, they carry the anterior portion of the globe obliquely toward that side which answers to the distance between these two muscles; and when all the four muscles act successively, they turn the globe of the eye round, which is what is called rolling the eyes.

The use of the oblique muscles is chiefly to counterbalance the action of the recti, and to support the globe in all the motions already mentioned. This is evident from

their

their inſertions, which are in a contrary direction to thoſe of the recti, their fixed points with relation to the motions of the globe being placed forward, and thoſe of the recti backward, at the bottom of the orbit.

The rectus externus, by being bent on the globe, not only hinders it from being carried outward, but alſo prevents the indirect motions of the obliqui from thruſting it out of the orbit toward the temples.

The SUPERCILIA, *and* MUSCULI FRONTALES, OCCIPITALES, *and* SUPERCILIARES.

The ſupercilia, or eye-brows, are the two hairy arches ſituated at the lower part of the forehead, between the top of the noſe and temples, in the ſame direction with the bony arches which form the ſuperior edges of the orbits. Their colour is different in different perſons, and often in the ſame perſon different from that of the hair on the head; the hairs of which they conſiſt are ſtrong and pretty ſtiff, and they lie obliquely, their roots being turned to the noſe, and their points to the temples.

The ſupercilia have motions common to them with thoſe of the ſkin of the forehead, and of the hairy ſcalp. By theſe motions the eye-brows are lifted up, the ſkin of the forehead is wrinkled more or leſs regularly and tranſverſely; and the hair and almoſt the whole ſcalp is moved, but not in the ſame degree in all perſons. The eye-brows have likewiſe particular motions which contract the ſkin above the noſe; and all theſe different motions are performed by the following muſcles.

The frontal muſcles are two thin, broad, fleſhy planes of unequal lengths, lying immediately behind the ſkin and membrana adipoſa, on the anterior parts of the forehead, which parts they cover from the root of the noſe, and through about two thirds of the arch of the eye-brows on each ſide, all the way to the lateral parts of the hair on the forehead. At the root of the noſe they touch each other as if they were but one muſcle; and at this place their fibres are ſhort and longitudinal, or vertical.

Theſe muſcles are fixed by the inferior extremities of their fleſhy fibres immediately in the ſkin, running thro' the membrana adipoſa. They cover the muſculi ſuperciliares, and adhere cloſely to them by a kind of intertexture. By the ſame fibres they ſeem to be inſerted in the angular apophyſes of the os frontis, and to be blended a little with the muſcles of the palpebræ and noſe. The upper extremities of their fleſhy fibres are fixed in the external or convex ſurface of the pericranium. Each of their lateral portions covers a portion of the temporal muſcle on the ſame ſide, and adheres very cloſely to it.

The occipital muſcles are two ſmall, thin, broad, and very ſhort fleſhy planes, ſituated on the lateral parts of the occiput, at ſome diſtance from each other. They are inſerted by the inferior extremities of their fleſhy fibres in the ſuperior tranſverſe line of the os occipitis, and alſo a little above it. From thence they run up obliquely from behind forward, and are fixed in the inner concave ſurface of the pericranium.

The breadth of theſe muſcles reaches from the poſterior middle part of the occiput, toward the maſtoid apophyſis, and they diminiſh unequally in length as they approach the apophyſes.

Theſe four muſcles ſeem always to act in concert, the occipitales being only auxiliaries or aſſiſtants to the frontales, the office of which is to raiſe the ſupercilia, by wrinkling the ſkin of the forehead.

The muſculi ſuperciliares are fleſhy faſciculi, ſituated behind the ſupercilia, and behind the inferior portion of the muſculi frontales, from the root of the noſe to above one half of each ſuperciliary arch. They are ſtrongly inſerted, partly in the ſynarthroſis of the oſſa naſi, with the os frontis, where they come very near the proper muſcles of the noſe, and partly in a ſmall neighbouring portion of the orbit. From thence they firſt run up a little, and afterwards more or leſs in the direction of the eye-brows. They are made up of ſeveral ſmall faſciculi of oblique fibres, all fixed by one end in the manner already ſaid, and by the other partly in the lower extremity of the muſcles by which they are covered, and partly in the ſkin of the ſupercilia.

The action of theſe muſcles is to depreſs the eye-brows, to bring them cloſe together, and to contract the ſkin of the fore-head immediately above the noſe, into longitudinal and oblique wrinkles, and the ſkin which covers the root of the noſe into irregular tranſverſe wrinkles.

The PALPEBRÆ *and* MEMBRANA CONJUNCTIVA.

THE palpebræ are a kind of veils or curtains placed tranſverſely above and below the anterior portion of the globe of the eye; and accordingly there are two eye-lids to each eye, one ſuperior, the other inferior. The ſuperior is the largeſt and moſt moveable in man. They both unite at each ſide of the globe, and the places of their union are termed *angles*, one large and internal, which is next the noſe, the other ſmall or external, which is next the temples.

The palpebræ are made up of common and proper parts. The common parts are the ſkin, epidermis, and membrana adipoſa. The proper parts are the muſcles, the tarſi, the puncta or foramina lachrymalia, the membrana conjunctiva, the glandula lachrymalis, and the particular ligaments which ſuſtain the tarſi. The tarſi and their ligaments are in ſome meaſure the baſis of all theſe parts.

The tarſi are thin cartilages forming the principal part of the edge of each palpebra; and they are broader at the middle than at the extremities. Thoſe of the ſuperior palpebræ are ſomething leſs than half an inch in breadth; but in the lower palpebræ they are not above the ſixth part of an inch; and their extremities next the temples are more ſlender than thoſe next the noſe.

Theſe cartilages are ſuited to the borders and curvature of the eye-lids. The lower edge of the ſuperior cartilage and upper edge of the inferior, terminate equally, and both may be termed the *ciliary edges*. The oppoſite edge of the upper tarſus is ſomething ſemi-circular between its two extremities; but that of the inferior tarſus is more uniform, and both are thinner than the ciliary edges.

The broad ligaments of the tarsi are membranous elongations formed by the union of the periosteum of the orbits and pericranium along both edges of each orbit. The superior ligament is broader than the inferior, and fixed to the superior edge of the upper cartilage, as the inferior is to the lower edge of the lower cartilage, so that these ligaments and the tarsi, taken alone or without the other parts, represent palpebræ.

The membrana conjunctiva is a thin membrane, one portion of which lines the inner surface of the palpebræ. At the edge of the orbit it has a fold, and is continued from hence on the anterior half of the globe of the eye, adhering to the tunica albuginea; so that the palpebræ and the forepart of the globe of the eye are covered by one and the same membrane, which does not appear to be a continuation of the pericranium, but has some connection with the broad ligaments of the tarsi.

The name of *conjunctiva* is commonly given only to that part which covers the globe, the other being called simply the *internal membrane* of the palpebræ; but we may very well name the one *membrana oculi conjunctiva*, and the other *membrana palpebrarum conjunctiva*. That of the palpebræ is a very fine membrane adhering very close, and full of small capillary blood-vessels. It is perforated by numerous imperceptible pores, through which a kind of serum is continually discharged.

The conjunctiva of the eye adheres by the intervention of a cellular substance, and is consequently loose, and as it were moveable; and it may be taken hold of and separated in several places from the tendinous coat. It is of a whitish colour; and being transparent, the albuginea makes it appear perfectly white: These two coats together forming what is called the *white of the eye*.

The lachrymal gland is white, and of the number of those called *conglomerate glands*. It lies under that depression observable in the arch of the orbit near the temples, and laterally above the globe of the eye. It is a little flatted, and divided as it were into two lobes, one of which lies toward the insertion of the musculus rectus superior, the other toward the rectus externus. It adheres very closely to the fat which surrounds the muscles and posterior convexity of the eye, and it was formerly named *glandula innominata*.

From this gland several small ducts go out, which run down almost parallel to each other, through the substance of the tunica interna or conjunctiva of the superior palpebra, and afterwards pierce it inwardly near the superior edge of the tarsus.

The flat edge of each palpebra is adorned with a row of hairs called *cilia*, or the *eye-lashes*. Those belonging to the superior palpebra are bent upward, and longer than those of the lower palpebra which are bent downward. These rows are placed next the skin, and are not single, but irregularly double or triple. The hairs are [illegible]er near the middle of the palpebræ than toward the [illegible]nd for about a quarter of an inch from the inner angle they are quite wanting.

Along the same border of the palpebræ, near the internal commissure, or toward the eye, we see a row of small holes which may be named *foramina* or *puncta ciliaria*. They are the orifices of the same number of small oblong glands which lie in the sulci, channels, or grooves on the inner surface of the tarsus. These little glands are of a whitish colour; and when squeezed, a sebaceous matter like soft wax, is discharged through the puncta ciliaria.

Near the great or internal angle of the palpebræ, the flat portion of their edges terminates in another which is rounder and thinner. By the union of these two edges an angle is formed.

At this place, the extremity of the flat portion is distinguished from the round portion by a small protuberance or papilla, which is obliquely perforated by a small hole in the edge of each palpebra. These two small holes are very visible, and often more so in living than in dead bodies, and they are commonly named *puncta lachrymalia*, being the orifices of two small ducts which open beyond the angle of the eye into a particular reservoir, termed *sacculus lachrymalis*, which shall be described in the article of the nose.

The puncta lachrymalia are opposite to each other, and so they meet when the eye is shut. Round the orifice of each of these points, we observe a whitish circle which seems to be a cartilaginous appendix of the tarsus, and which keeps the orifice always open.

The caruncula lachrymalis is a small reddish, granulated, oblong body, situated precisely between the internal angle of the palpebræ and globe of the eye. The substance of it seems to be wholly glandular. We discover upon it a great number of fine hairs covered by an oily, yellowish matter; and on the globe of the eye, near this glandular body, we see a semilunar fold, formed by the conjunctiva, the concave side of which is turned to the uvea, and the convex side to the nose.

The Muscles *of the* Palpebræ.

The muscles of the palpebræ are commonly reckoned to be two, one peculiar to the upper eye-lid, named *levator palpebræ superioris*; the other common to both, called *musculus orbicularis palpebrarum*.

The levator palpebræ superioris is a very thin muscle, situated in the orbit above, and along the rectus superior oculi. It is fixed to the bottom of the orbit, by a small narrow tendon, near the foramen opticum, between the posterior insertions of the rectus superior and obliquus superior. From thence its fleshy fibres run forward on the rectus, increasing gradually in breadth, and terminate by a very broad aponeurosis in the tarsus of the superior palpebra.

By the musculus palpebrarum obliquus we understand all that extent of fleshy fibres, which by a thin stratum surrounds the edge of each orbit, and from thence, without any interruption, covers the two palpebræ all the way to the cilia. Almost all of them have a common tendon situated transversely between the internal angle of the eye and the nasal apophysis of the os maxillare. This is a slender ligamentary tendon, strongest where it is fixed in the bone, and diminishing gradually as it approaches the angle of the palpebræ, where it terminates

at

at the union of the points, or at the extremities of the two tarſi.

This muſcle is divided into four portions, whereof the firſt is that which ſurrounds the orbit. The ſecond portion is that which lies between the upper edge of the orbit and the globe of the eye, and which covers the inferior edge of the orbit below, ſome of its fibres being fixed to both edges of the orbit.

The third portion ſeems to belong more particularly to the palpebræ, and the greateſt part of it is ſpent in the palpebra ſuperior. The fibres of this portion meet at the two angles of the eye, where they appear to make very acute inflections without any diſcontinuation.

The fourth portion is an appendix to the third, from which it differs chiefly in this, that its fibres do not reach to the angles, and form only ſmall arches, the extremities of which terminate in each palpebra.

All theſe different portions of the orbicular muſcle adhere to the ſkin, which covers it from the upper part of the noſe to the temples, and from the ſupercilium to the upper part of the cheek. When they contract, ſeveral wrinkles are formed in the ſkin, which vary according to the different directions of the fibres.

The USES *of the* EYE, *and of its Appendages, in general.*

EVERY body knows that the eye is the organ of viſion. The tranſparent parts of the globe modify the rays of light, by different refractions; the retina and choroides receive the different impreſſions of theſe rays; and the optic nerve carries theſe impreſſions to the brain. When objects are at a great diſtance or obſcure, the pupilla is dilated; and it is contracted when objects are near, or placed in a great light. The muſcles of the globe of the eye and of the palpebræ perform the motions already deſcribed.

The glandula lachrymalis continually moiſtens the forepart of the globe of the eye; and the lachrymal ſerum is equally ſpread over that globe by the motions of the ſuperior palpebra, the inner ſurface of which is in a ſmall meaſure villous. The union of the two palpebræ directs this ſerum towards the puncta lachrymalia; and the unctuous matter, diſcharged through the foramina ciliaria, hinders it from running out between the palpebræ. The large ſize and viſcid ſurface of the caruncula prevents it from running beyond the puncta, and thus forces it into them.

The ſupercilia may hinder ſweat from falling on the eyes. The ſuperior cilia, which are longer than the inferior, may have the ſame uſe; and they both ſerve to prevent duſt, inſects, *&c.* from entering the eyes when they are only a little open.

SECT. VI. *The* NOSE.

THE bones of the noſe have already been deſcribed in the ſutures of the bones of the head,

The ſoft parts are the integuments, muſcles, ſacculus lachrymalis, membrana pituitaria, and hairs of the nares.

The internal nares, or the two cavities of the noſe, comprehend the whole ſpace between the external nares and poſterior openings immediately above the arch of the palate; from whence theſe cavities reach upward as far as the lamina cribroſa of the os ethmoides, where they communicate forward with the ſinus frontales, and backward with the ſinus ſphenoidales. Laterally, theſe cavities are bounded on the inſide by the ſeptum narium, and on the outſide, or that next the cheeks, by the conchæ, between which they communicate with the ſinus maxillaris.

The particular ſituation of theſe cavities deſerves our attention. The bottom of them runs directly backward, ſo that a ſtreight and pretty large ſtilet may eaſily be paſſed from the external nares, under the great apophyſis of the occipital bone. The openings of the maxillary ſinuſes are nearly oppoſite to the upper edge of the oſſa malarum. The openings of the frontal ſinuſes are more or leſs oppoſite to, and between the pulleys or rings of the muſculi trochleares; and by theſe marks the ſituation of all the other parts may be determined.

The inferior portion of the external noſe is compoſed of ſeveral cartilages, which are commonly five in number, and of a pretty regular figure. The reſt are only additional, ſmaller, more irregular, and the number of them more uncertain. Of the five ordinary cartilages, one is ſituated in the middle, the other four laterally. The middle cartilage is the moſt conſiderable, and ſupports the reſt, being connected immediately to the bony parts; but the other four are connected to the middle cartilage, and to each other, by means of ligaments.

The ſub-ſeptum, or portion under the ſeptum narium, is a pillar of fat applied to the inferior edge of the cartilaginous partition, in form of a ſoft moveable appendix. The thickneſs of the alæ narium, and eſpecially that of their lower edges, is not owing to the cartilages, which are very thin, but to the ſame kind of ſolid fat with which theſe cartilages are covered. The great cartilage is immoveable by reaſon of its firm connection to the bony parts of the noſe; but the lateral cartilages are moveable, becauſe of their ligamentary connections, and they are moved in different manners by the muſcles belonging to them.

The external noſe is covered by the common integuments, the ſkin, epidermis, and fat. Thoſe which cover the tip of the noſe and alæ narium are a great number of glandular bodies, called *glandulæ ſebaceæ*, the contents of which may eaſily be ſqueezed out by the fingers.

Six muſcles are commonly reckoned to belong to the noſe; two recti, called alſo *pyramidales* or *triangulares*; two obliqui, or laterales; and two tranſverſi, or myrtiformes. The noſe may alſo be moved in ſome meaſure by the muſcles of the lips, which in many caſes become aſſiſtants to the proper muſcles of this organ.

The muſculus pyramidalis, or anterior, on each ſide, is inſerted by one extremity in the ſynarthroſis of the os frontis and oſſa naſi, where its fleſhy fibres mix with thoſe of the muſculi frontales and ſuperciliares. It is very flat, and runs down on the ſide of the noſe, increaſing gradually in breadth, and terminating by an aponeuroſis, which repreſents the baſis of a pyramid, and is inſerted

serted in the moveable cartilage which forms the ala of the nares.

The oblique or lateral muſcle is a thin fleſhy plane, lying on the ſide of the former. The lateral muſcle is fixed by its upper extremity to the apophyſis naſalis of the os maxillare, below its articulation with the os frontis, and ſometimes a little lower than the middle of the inner edge of the orbit. From thence it runs toward the ala narium, and is inſerted in the moveable cartilage, near the os maxillare, being covered laterally by a portion of the neighbouring muſcle of the upper lip.

The tranſverſe or inferior muſcle, called alſo *myrtiformes*, is inſerted by one end in the os maxillare, near the lower edge of the orbit, much about the place which anſwers to the extremity of the ſocket of the dens caninus on the ſame ſide. From thence it runs almoſt tranſverſely upward, and is fixed in the lateral cartilages of the noſe, over which it ſometimes runs to the alæ of the great cartilage, to be inſerted there.

The firſt two pairs of theſe muſcles raiſe and dilate the alæ of the nares when they act; and at the ſame time raiſe the upper lip, by reaſon of their connection with the muſcles of that part. They likewiſe wrinkle the ſkin on the ſides of the noſe.

The membrana pituitaria is that which lines the whole internal nares, the cellular convolutions, the conchæ, the ſides of the ſeptum narium, and, by an uninterrupted continuation, the inner ſurface of the ſinus frontales and maxillares, and of the ductus lacrymales, palatini, and ſphenoidales. It is likewiſe continued down from the nares to the pharynx, ſeptum palati, *&c.*

It is termed *pituitaria*, becauſe, through the greateſt part of its large extent, it ſerves to ſeparate from the arterial blood a mucilaginous lympha, called *pituita* by the ancients, which in the natural ſtate is pretty liquid; but it is ſubject to very great changes, becoming ſometimes glutinous or ſnotty, ſometimes limpid, *&c.* neither is it ſeparated in equal quantities through the whole membrane.

When we carefully examine this membrane, it appears to be of a different ſtructure in different parts. Near the edge of the external nares it is very thin, appearing to be the ſkin and epidermis in a degenerated ſtate. All the other parts of it in general are ſpungy, and of different thickneſſes. The thickeſt parts are thoſe on the ſeptum narium, on the whole lower portion of the internal nares, and on the conchæ.

On the ſide next the perioſteum and perichondrium it is plentifully ſtored with ſmall glands, the excretory ducts of which are very long near the ſeptum narium, and their orifices very viſible.

The frontal, maxillary and ſphenoidal ſinuſes open into the internal nares, but in different manners. The frontal ſinuſes open from above downward, anſwering to the infundibula of the os ethmoides. The ſphenoidales open forwards, oppoſite to the poſterior orifices of the nares; and the maxillares open a little higher, between the two conchæ.

The opening of the ſinus maxillaris in ſome ſubjects is ſingle, in others double; it lies exactly between the two conchæ, about the middle of their depth.

It is proper here to obſerve the whole extent of the maxillary ſinus. Below, there is but a very thin partition between it and the dentes molares, the roots of which do, in ſome ſubjects, perforate that ſeptum. Above, there is only a very thin tranſparent lamina between the orbit and the ſinus. Backward, above the tuberoſity of the os maxillare, the ſides of the ſinus are very thin, eſpecially at the place which lies before the root of the apophyſis pterygoides, through which the inferior maxillary nerve ſends down a ramus to the foramen palatinum poſterius, commonly called *guſtatorium*. Inward, or toward the conchæ narium, the bony part of the ſinus is likewiſe very thin.

The lachrymal ſacculus is an oblong membranous bag, into which the ſerous fluid is diſcharged from the eye through the puncta lachrymalia; and from which the ſame fluid paſſes to the lower part of the internal nares. It is ſituated in a bony groove and canal, formed partly by the apophyſis naſalis of the os maxillare and os unguis, partly by the ſame os maxillare and lower part of the os unguis, and partly by this lower portion of the os unguis and a ſmall ſuperior portion of the concha narium inferior.

This bony lachrymal duct runs down for a little way obliquely backward, toward the lower and lateral part of the internal nares on each ſide, where its lower extremity opens on one ſide of the ſinus maxillaris under the inferior concha. The upper part of this duct is only an half canal or groove; the lower is a complete canal, narrower than the former.

The ſacculus lachrymalis may be divided into a ſuperior or orbitary portion, and an inferior or naſal portion. The orbitary portion fills the whole bony groove, being ſituated immediately behind the middle tendon of the muſculus orbicularis. The naſal portion lies in the bony canal of the noſe, being narrower and ſhorter than the former.

The orbitary portion is diſpoſed at its upper extremity, much in the manner of an inteſtinum cæcum, and at the lower extremity is continued with the portio naſalis. Towards the internal angle of the eye, behind the tendon of the orbicular muſcle, it is perforated by a ſmall ſhort canal formed by the union of the lachrymal ducts.

The naſal portion having reached the lower part of the bony duct under the inferior concha, terminates in a ſmall, flat, membranous bag, the bottom of which is perforated by a round opening.

The ſubſtance of this ſacculus is ſomething ſpongy or cellulous, and pretty thick, being ſtrongly united by its convex ſide to the perioſteum of the bony canal.

The ductus inciſorii, or naſo-palatini of Steno, are two canals which go from the bottom of the internal nares croſs the arch of the palate, and open behind the firſt or largeſt dentes inciſorii. Their two orifices may be diſtinctly ſeen in the ſkeleton at the lower part of the naſal foſſæ, on the anterior and lateral ſides of the criſtæ maxillares; and we may likewiſe perceive their oblique paſſage through the maxillary bones, and laſtly their inferior orifices in a ſmall cavity or foſſula, called *foramen palatinum anterius*.

The

The noſe is the organ of ſmelling, by means of the villous portion of the internal membrane, to which the olfactory nerves are chiefly diſtributed. It is likewiſe of uſe in reſpiration; and the mucilaginous fluid ſpread over the whole pituitary membrane, prevents the air from drying that membrane, and ſo rendering it incapable of being affected. The noſe ſerves likewiſe to regulate and modify the voice, and to this the ſinuſes likewiſe contribute. The ſacculus lachrymalis receives the ſerum from the eyes, and diſcharges it upon the palate, from whence the greateſt part of it runs to the pharynx.

SECT. VII. *The* EAR.

ANATOMISTS commonly divide or diſtinguiſh the ear into external and internal. By the external ear they mean all that lies without the external orifice of the meatus auditorius in the os temporis; and by the internal ear, all that lies within the cavities of that bone, and alſo the parts that bear any relation thereto.

The greateſt part of the external ear conſiſts of a large cartilage very artificially framed, which is the baſis of all the other parts of which this portion of the ear is made up. The internal ear conſiſts chiefly of ſeveral bony pieces, partly formed in the ſubſtance of the oſſa temporum, and eſpecially in that portion of it called *apophyſis petroſa*, and partly ſeparated from, but contained in a particular cavity of that bone.

The external ear, taken altogether, reſembles in ſome degree the ſhell of a muſſel, with its broad end turned upward, the ſmall end downward, the convex ſide next the head, and the concave ſide outward. Two portions are diſtinguiſhed in the external ear taken all together; one large and ſolid, called in Latin *pinna*, which is the ſuperior, and by much the greateſt part; the other ſmall and ſoft, called the *lobe*, which makes the lower part.

The foreſide is divided into eminences and cavities. The eminences are four in number, called *helix*, *anthelix*, *tragus*, and *antitragus*. The helix is the large folded border or circumference of the great portion of the ear. The anthelix is the large oblong eminence or riſing ſurrounded by the helix. The tragus is the ſmall anterior protuberance below the anterior extremity of the helix, which in an advanced age is covered with hairs. The antitragus is the poſterior tubercle below the inferior extremity of the anthelix.

The cavities on the foreſide are four in number; the hollow of the helix; the depreſſion at the ſuperior extremity of the anthelix, called *foſſa navicularis*; the concha, or great double cavity that lies under the riſing termed *anthelix*, the upper bottom of which is diſtinguiſhed from the lower by a continuation of the helix in form of a tranſverſe criſta; and laſtly, the meatus of the external ear ſituated at the lower part of the bottom of the concha.

The backſide of the external ear ſhews only one conſiderable eminence, which is a portion of the convex ſide of the concha, the other portion being hid by the adheſion of the ear to the os temporis.

The other parts of the external ear, beſides the cartilage, are ligaments, muſcles, integuments, ſebaceous and ceruminous glands, arteries, veins and nerves.

The cartilage of the outward ear is nearly of the ſame extent and figure with the large ſolid portion thereof, already mentioned; but it is not of the ſame thickneſs, being covered by integuments on both ſides. In the lobe or ſoft lower portion of the ear, this cartilage is wanting.

The external ear is fixed to the cranium, not only by the cartilaginous portion of the meatus auditorius, but alſo by ligaments, which are two in number, one anterior, the other poſterior. The anterior ligament is fixed by one extremity to the root of the apophyſis zygomatica of the os temporis, at the anterior and a little toward the ſuperior part of the meatus oſſeus, cloſe to the corner of the glenoid cavity; and by the other extremity, to the anterior and ſuperior part of the cartilaginous meatus.

The poſterior ligament is fixed by one end to the root of the maſtoid apophyſis, and by the other to the poſterior part of the convexity of the concha, ſo that it is oppoſite to the anterior ligament.

Of the muſcles of the external ear, ſome go between the cartilages and the os temporis, others are confined to the cartilages alone. Both kinds vary in different ſubjects, and are ſometimes ſo very thin, as to look more like ligaments than muſcles. The muſcles of the firſt kind are generally three in number, one ſuperior, one poſterior, and one anterior. The ſuperior muſcle is fixed in the convexity of the foſſa navicularis, and of the ſuperior portion of the concha; from whence it runs up to the ſquamous portion of the os temporis, expanding in a radiated manner, and is inſerted principally in the ligamentary aponeuroſis, which covers the poſterior portion of the temporal muſcle.

The anterior muſcle is ſmall, more or leſs inverted, and like an appendix to the ſuperior. It is fixed by one extremity above the root of the zygomatic apophyſis, and by the other in the anterior part of the convexity of the concha.

The poſterior muſcle is almoſt tranſverſe, and of a conſiderable breadth, being fixed by one end to the poſterior part of the convexity of the concha, and by the other in the root of the maſtoid apophyſis.

The ſmall muſcles which are confined to the cartilages are only ſmall ſtrata of fibres found on both ſides of the cartilages.

The lobe of the ear, or that ſoft portion which lies under the tragus, antitragus, and meatus auditorius, is made up of nothing but ſkin and cellular ſubſtance. The meatus auditorius is partly bony, and partly cartilaginous. The bony portion is the longeſt, and forms the bottom of the canal. The cartilaginous portion is the ſhorteſt, and forms the external opening or orifice of the canal.

Theſe two portions joined endwiſe to each other, form a canal of about three quarters of an inch in length, of different wideneſs in its different parts, and a little contorted. It is lined on the inſide by the ſkin and cellular membrane, through its whole length; and thus theſe integuments make up for the breaks in the cartilaginous portion,

portion, and form a kind of cutaneous tube in the other portion.

The ſkin which covers both ſides of the cartilage contains a great number of ſmall glands, which continually diſcharge an oily whitiſh humour, collected chiefly near the adheſions of the ear to the head, and under the fold of the helix; and theſe glands are of the ſebaceous kind. The ſkin which lines the meatus auditorius contains another kind of glands, of a yellowiſh colour, and which may be plainly ſeen on the convex ſide of the cutaneous tube already mentioned.

Theſe glands are diſpoſed in ſuch a manner as to leave reticular ſpaces between them, and they penetrate a little way into the ſubſtance of the ſkin. They are called *glandulæ ceruminoſæ*, becauſe they diſcharge that matter which is named *cerumen*, or the *wax of the ear*. The inner ſurface of the cutaneous tube is full of fine hairs, between which lie the orifices of the ceruminous glands. The firſt place in which we meet with theſe glands is on that part of the convex ſide of the cutaneous tube which ſupplies the breaks of the cartilaginous meatus.

All the bony parts of the organ of hearing, or bones of the internal ear, being contained in the inferior portions of the oſſa temporum; it will be very proper to recollect what has been already ſaid about theſe, in Part I.

All the bony organ of hearing may be divided into four general parts: 1. The external meatus auditorius; 2. The tympanum or barrel of the ear; 3. The labyrinth; 4. The internal meatus auditorius. It may likewiſe be divided into immoveable or containing parts, which take in all the four already mentioned; and moveable or contained parts, which are four little bones lodged in the tympanum, called *incus*, *malleus*, *ſtapes*, and *os orbiculare* or *lenticulare*.

The external auditory paſſage begins by the external auditory hole, the edge of which is rough and prominent; but backwards towards the maſtoid apophyſis it appears very much ſloped. The paſſage itſelf is about half an inch in length, running obliquely from behind forward, in a curve direction, and ſometimes winding a little in the middle, like a ſcrew. Its cavity is almoſt oval, wider at the entry than at the middle, after which it widens again by degrees.

It terminates inwardly by an even circular edge lying in a plane very much inclined, the upper part of it being turned outward, and the lower part inward; ſo that the whole canal is longer on the lower ſide than on the upper. The concave ſide of the circular edge is grooved quite round.

In children this bony canal is wanting, as well as the maſtoid apophyſis; and the inner circular edge is a diſtinct ring, which in an advanced age unites intirely, and becomes one piece with the reſt. It is termed the *bony circle* in infants, and indeed it is very eaſily ſeparated from all the other parts.

It would ſeem therefore, that the whole bony canal in adults is only a prolongation of the bony circle in children; becauſe even in a more advanced age, the whole canal may, without much difficulty, be taken out. The circular groove lies between the maſtoid apophyſis and the articular fiſſure or crack.

The tympanum or barrel of the ear is a cavity irregularly ſemi-ſpherical, the bottom of it being turned inward, and the mouth joined to the circular groove already mentioned. Both eminences and cavities are obſervable in it.

The remarkable eminences are three in number; a large tuberoſity lying in the very bottom of the barrel, a little toward the back part; and a ſmall irregular pyramid ſituated above the tuberoſity, and a little more backward; the apex of it is perforated by a ſmall hole, and on one ſide of the baſis two ſmall bony filaments are often found in a parallel ſituation. In the third eminence is a cavity ſhaped like the mouth of a ſpoon, ſituated at the upper and a little towards the anterior part of the bottom of the tympanum.

The principal cavities in the tympanum are, the opening of the maſtoid cells or ſinuoſities; the opening of the Euſtachian tube; the bony half-canal; the feneſtra ovalis and rotunda; and to theſe may be added the ſmall hole in the pyramid.

The opening in the maſtoid cells is at the poſterior and upper part of the edge of the barrel. The cells themſelves which end there are dug in the ſubſtance of the maſtoid proceſs, being very irregular and full of windings and turnings.

The opening of the Euſtachian tube is at the anterior and a little toward the upper part of the edge of the barrel. This tube runs from the tympanum, towards the poſterior openings of the naſal foſſæ, and arch of the palate. The bony portion thereof is dug in the apophyſis petroſa, along the duct of the carotid apophyſis; and when it leaves that, it is lengthened out by the ſpinal apophyſis of the os ſphenoides.

The bony half-canal, of which the cavity reſembling the mouth of a ſpoon is the extremity, lies immediately above the Euſtachian tube, towards the upper ſide of the apophyſis petroſa, or rather in the very ſubſtance of that upper ſide.

The feneſtra ovalis is a hole of communication between the tympanum and labyrinth. It lies immediately above the tuberoſity, the upper ſide of it being a little rounded, the lower a little flatted; and one extremity being turned forward, the other backward.

The feneſtra rotunda is ſomething leſs than the ovalis, and ſituated in the lower, and a little towards the poſterior part of the large tuberoſity; the opening of it, which is the orifice of a particular duct in the labyrinth, lying obliquely backward and outward.

The hole in the apex of the pyramid is the orifice of a cavity, which may be named the *ſinus of this pyramid*.

The tympanum contains ſeveral little bones called *the bones of the ear*. They are generally four in number, denominated from ſomething to which they are thought to bear a reſemblance, *viz.* incus, malleus, ſtapes, and os orbiculare or lenticulare

The incus, or anvil, reſembles, in ſome meaſure, one of the anterior grinders with its roots at a great diſtance from each other; at leaſt it comes nearer to this than to the ſhape of the anvil. It may be divided into a body and branches. The body is a large ſubſtance, the branches

branches or legs are two, one long and one short. The body is turned forward, the short leg backward, and the long leg downward.

The body of the incus is broader than it is thick. It has two eminences, and two cavities between them, much in the same manner as we see in the crown of the first grinders.

The short leg is thick at its origin, and from thence decreasing gradually, it ends in a point. It is situated horizontally, its point being turned backward, and joined to the edge of the mastoid opening of the tympanum.

The long leg, viewed through the external auditory passage, appears to be situated vertically; but if we look upon it either on the fore or backside, we see it is inclined, the extremity of it being turned much more inward, than the root or origin. The point of the extremity is a little flatted, and bent inward like a hook, and sometimes a little hollowed like a kind of ear-picker.

The malleus or hammer is a long bone, with a large head, a small neck, an handle, and two apophyses, one in the neck, the other in the handle.

The top of the head is considerably rounded, and from thence it contracts all the way to the neck. Both head and neck are in an inclined situation, and the eminences and cavities in it answer to those in the body of the incus.

The handle is looked upon by some as one of the apophyses of the malleus; and in that case, it is the greatest of the three. It forms an angle with the neck and head, near which it is something broad and flat, and decreases gradually toward its extremity.

The apophysis of the handle, termed by others the small or short apophysis of the malleus, terminates the angle already mentioned, being extended towards the neck, and lying in a straight line with that side or border of the handle which is next it.

The apophysis of the neck, called also *apophysis gracilis*, is in a natural state very long, but so slender withal, that it is very easily broken, especially when dry; it arises from the neck, and sometimes appears much longer than it really is, by the addition of a small dried tendon sticking to it.

The stapes is a small bone, very well denominated from the resemblance it bears to a stirrup. It is divided into the head, legs, and basis.

The head is placed upon a short flatted neck, the top of it being sometimes flat, sometimes a little hollow.

The two legs taken together, form an arch, like that of a stirrup, in the concave side of which is a groove, which runs through their whole length. One leg is longer, more bent, and a little broader than the other.

The basis resembles that of a stirrup, both in its oval shape, and union with the legs, except that it is not perforated as the stirrups now are, but solid, like those of the ancients. Round its circumference, next the legs, is a little border, which makes that side of the basis appear a little hollow. The other side is pretty smooth, and one half of the circumference is something more curve than the other.

The orbicular or lenticular bone is the smallest bone in the body. It lies between the head of the stapes and extremity of the long leg of the incus, being articulated with each of these. In dry bones it is found very closely connected, sometimes to the stapes, sometimes to the incus, and might in that state be easily mistaken for an epiphysis of either of these bones.

The labyrinth is divided into three parts, the anterior, middle, and posterior. The middle portion is termed *vestibulum*; the anterior, *cochlea*; and the posterior, the *labyrinth* in particular, which comprehends the three semicircular canals.

The vestibulum is an irregularly round cavity, less than the tympanum, and situated more inward and a little more forward. These two cavities are, in a manner, set back to back, with a common partition-wall between them, perforated near the middle by the fenestra ovalis, by which the cavities communicate with one another.

The cavity of the vestibulum is likewise perforated by several other holes; on the outside, or towards the tympanum, by the fenestra rotunda; on the backside, by the five orifices of the semicircular canals; on the lower part of the foreside, by two holes, which are the entry of the cochlea; and on the fore-side, towards the internal meatus auditorius, opposite to the fenestra ovalis, by a great many very small holes for the passage of the nerves.

The semicircular canals are three in number, one vertical and superior, one vertical and posterior, and one horizontal. The superior vertical canal is situated transversely with respect to the apophysis petrosa, the convex side or curvature of it being turned upward, and the extremities downward, one inward, the other outward. The posterior vertical canal lies parallel to the length of the apophysis, the curvature being turned backward, and the extremities forward, one upward, the other downward; and the superior extremity of this canal meets and loses itself in the internal extremity of the former. The curvature and extremities of the horizontal canal are almost on a level; the curvature lying obliquely backward, and the extremities forward, ending under those of the superior vertical canal, but a little nearer each other; and the inner being almost in the middle space, between the extremities of the posterior vertical canal.

The horizontal canal is generally the least of the three; the posterior vertical is often, and the superior vertical sometimes, the greatest; all the three canals are larger than a semicircle, forming nearly three quadrants; they are broader at the orifices than in the middle. These orifices open into the back-side of the vestibulum, being but five in number, so that in the posterior part of the vestibulum, two appear towards the inside, and three towards the outside.

The cochlea is a sort of spiral shell, with two ducts, formed in the anterior part of the apophysis petrosa, in some measure resembling the shell of a snail. The parts to be distinguished in it, are the basis, the apex, the spiral lamina, or half septum, by which its cavity is divided into two half-canals; the spindle round which the cochlea turns; and lastly, the orifices and union of the two ducts.

The basis is turned directly inward, toward the internal foramen auditorium, the apex outward, and the axis of the spindle is nearly horizontal.

The basis of the cochlea is gently hollowed, and towards the middle perforated by several small holes. The spindle is a kind of short cone, with a very large basis, which is the middle of the basis of the cochlea. Thro' its whole length runs a double spiral groove, which, through a microscope, shews a great number of pores.

The cochlea makes about two turns and an half from the basis to the apex; and the two ducts, being strictly united together through their whole course, form an entire common septum, which must not be confounded with the half septum or spiral lamina, as is often done. The first might be termed the common septum, the other the particular septum or half-septum.

Both of them are closely joined to the spindle, being thicker there than in any other place. The common septum is complete, and separates the turns entirely from each other; whereas the half-septum in the skeleton is only a spiral lamina, the breadth of which is terminated all round by a very thin border lying in the middle cavity of the cochlea. In the natural state, there is a membranous half-septum, which completes the partition between the two ducts.

The two half-canals turn jointly about the spindle, one being situated towards the basis of the cochlea, the other towards the apex: for which reason they have been termed the one internal, and the other external; the division of them into the upper and lower flight, not being agreeable to the natural state, but liable to convey a very false idea thereof.

The spiral or volute of the cochlea, begins at the lower part of the vestibulum, runs from thence forward to the top, then backward down to the bottom, afterwards upwards and forwards, and so on from the basis which is turned inward, to the apex which is turned outward.

The two half-canals communicate fully at the apex of the cochlea. Their separate openings are towards the basis, one of them being immediately into the lower part of the foreside of the vestibulum, the other into the fenestra rotunda.

The internal auditory hole is in the backside of the apophysis petrosa, in some measure behind the vestibulum and basis of the cochlea. It is a kind of blind hole, divided into two fossulæ, one large, the other small. The large one lies lowest, and serves for the portio mollis of the auditory nerve or seventh pair. The small one is uppermost, and is the opening of a small duct through which the portio dura of the same nerve passes.

The inferior fossula is full of little holes, which, in the natural state, are filled with nervous filaments of the portio mollis, which go to the spindle, to the semicircular canals, and to those of the cochlea. It is this fossula which forms the shallow cavity at the basis of the spindle of the cochlea.

The passage for the portio dura of the auditory nerve runs behind the tympanum, and its orifice is the stylo-mastoid hole. It begins by the small fossula, and pierces from within, outwards, the upper part of the apophysis petrosa, making there an angle or curvature. From thence it is inclined backward, behind the small pyramid of the tympanum, and runs down to the stylo-mastoid hole. It communicates likewise, by a small hole, with the sinus of the pyramid; and lower down, by another hole, with the barrel of the ear.

The internal parts of the ear are chiefly the membrana tympani, the periosteum of the barrel, officula auditus, labyrinth and all its cavities, the membrana mastoidæa interna, the muscles of the officula, and the parts which complete the formation of the Eustachian tube.

The Eustachian tube is a canal or duct which goes from the tympanum to the posterior openings of the nares, or nasal fossæ, and toward the arch of the palate.

The bony portion of it lies through its whole length immediately above the fissure of the glenoid or articular cavity of the os temporis, and terminates at the meeting of the spinal apophysis of the os sphenoidale with the apophysis petrosa of the os temporis.

The other or mixed portion reaches in the same direction from this place to the internal ala of the apophysis pterygoides, or to the posterior and outer edge of the nares. It is properly divided into four parts, two superior, and two inferior.

The two upper parts or quarters are bony; and of these the innermost is formed by the side of the apophysis petrosa, the outermost by the side of the apophysis spinalis of the os sphenoides, so that the upper half of this portion of the tube is bony. Of the two inferior parts, the internal is cartilaginous, and the external membranous; so that the lower half of this portion of the tube is partly cartilaginous next the os sphenoidale, and partly membranous next the apophysis petrosa.

The Eustachian tube thus formed, is very narrow in the bony part next the ear. The other portion grows gradually wider, especially near the posterior nares, where the inner cartilaginous side terminates by a prominent edge, and the outer side joins that of the neighbouring nostril. The cavity of the tube is lined by a membrane like that of the internal nares, of which it appears to be a continuation.

The situation of the two tubes is oblique, their posterior extremities at the ears being at a greater distance than the anterior at the nares, and the convex sides of the prominent edges are turned toward each other. The openings of the tubes are oval at this place, as is likewise their whole cavity, especially that of the mixed portion.

The membrana tympani is a thin, transparent, flattish pellicle, the edge of which is round, and strongly fixed in the orbicular groove which divides the bony meatus of the external ear from the tympanum or barrel. This membrane is very much stretched or very tense, and yet not perfectly flat: for on the side next the meatus externus it has a small hollowness, which is pointed in the middle; and on the side next the tympanum it is gently convex, and also pointed in the middle.

This membrane is situated obliquely, the upper part of its circumference being turned outward, and the lower part inward, suitably to the direction of the bony groove already mentioned. It is made up of several very fine laminæ, closely united together. The external lamina is in some measure a production of the skin and cuticula of the external meatus; the internal lamina is a continuation of the periosteum of the tympanum; and when the membrane has been first macerated in water, each

each of these laminæ may be subdivided into several others.

The depression in the middle of the membrana tympani is caused by the adhesion of the little bone called *malleus*, the handle of which is closely joined to the inside of the membrane from the upper part of the circumference all the way to the center to which the end of the handle is fixed. This handle seems to lie in a very fine membranous duplicature, by means of which it is tied to the membrana tympani, and which serves it for a periosteum.

The periosteum of the tympanum or barrel of the ear produces that of the small bones; it is likewise continued over the two fenestræ, and enters the eustachian tube, where it is lost in the inner membrane of that duct.

The cellulæ mastoidæi are very irregular cavities in the substance of the mastoid apophysis, which communicate with each other, and have a common opening towards the inside, and a little above the posterior edge of the orbicular groove. These cells are lined by a fine membrane, which is partly a continuation of the periosteum of the tympanum, and partly seems to be of a glandular structure like a kind of the membrana pituitaria. The mastoid opening is opposite to the small opening of the Eustachian tube, but a little higher.

The ligaments of the ossicula come next in order. The incus is tied by a strong short ligament, fixed in the point of the short leg, to the edge of the mastoid opening. Between the incus and malleus we find a small, thin cartilage. The malleus is connected through the whole length of its handle to the inside of the membrana tympani.

The malleus has three muscles, one external, one anterior, and one internal; and the stapes has one muscle. The external or superior muscle of the malleus, is a thin fasciculus of fleshy fibres lying along the upper part of the bony meatus auditorius, between the periosteum and the other integuments. The outer part of it is pretty broad, and it contracts by degrees as it advances towards the upper part or break of the orbicular groove of the tympanum, into which it enters by a small tendon, above the membrana tympani, and is inserted in the neck of the malleus, near the small eminence or short apophysis of the handle.

The anterior muscle of the malleus, is fleshy, long, and thin. It runs along the outside of the Eustachian tube, to which it adheres very closely through its whole length. Its anterior extremity is fixed in that side of the tube just before the sphenoidal spine; and the posterior extremity ends in a long thin tendon, which runs in the articular or glenoid fissure of the os temporis, through a small oblique notch; in which fissure it enters the tympanum, and is inserted in the long thin apophysis of the malleus. It is partly accompanied by a nerve, which forms what is called the *chorda tympani*.

The internal muscle of the malleus is very fleshy and distinct. It lies along the inside of the Eustachian tube, partly on the cartilaginous, and partly on the bony portion, being fixed by one extremity in the apophysis petrosa. Afterwards it runs along the cavity of the bony half-canal of the tympanum, within which cavity it is invested by a portion of a membranous or ligamentary vagina, which being fixed to the edges of the half-canal, forms an intire tube therewith.

At the extremity of this bony half-canal, where we observe the cavity shaped like the mouth of a spoon, this muscle ends in a tendon, which is bent round the transverse bony or ligamentary ridge in the last-named cavity, as over a pulley, and is inserted in the neck of the malleus above the small apophysis, advancing likewise as far as the handle.

The muscle of the stapes is short and thick, and lies concealed within the small bony pyramid at the bottom of the tympanum. The cavity which it fills, touches very nearly the bony canal of the portio dura of the auditory nerve; and it terminates in a small tendon which goes out of the cavity through the small hole in the apex of the pyramid. As it goes through the hole it turns forward, and is inserted in the neck of the stapes on the side of the longest and most crooked leg of that bone.

The three parts of the labyrinth, that is, the vestibulum, semicircular canals, and cochlea, are lined by a fine periosteum, which is continued over all the sides of their cavities, and shuts the two fenestræ of the tympanum.

The periosteum of the two sides of the bony spiral lamina advances beyond the edge of that lamina, and forms a membranous duplicature, which extending to the opposite side compleats the spiral septum.

This septum separates the two half-canals from the basis to the apex; but there it leaves a small opening, by which the small extremities of the half-canals communicate with each other. The large extremity of the external half-canal ends by an oblique turn in the fenestra rotunda, which is shut by a continuation of the periosteum of that canal. The large extremity of the other half-canal opens into the vestibulum; and these two extremities are intirely separated by a continuation of the periosteum.

The ear is the organ of which we can most distinctly unfold the structure, and demonstrate the greatest number of parts, that is, of small machines of which it is made up. We know likewise in general, that it is the organ of hearing; but when we endeavour to discover the uses of each of these parts, that is, how each contributes to the great design of the whole, after having thoroughly examined them, we must be obliged to own, that the greatest part of what the most able philosophers have said upon this subject, is without any real foundation.

Sect. VIII. *The* Mouth.

The mouth may be distinguished into external and internal, and the parts of which it consists may likewise come under the same two general heads.

The parts of the neck still undescribed are only the larynx, pharynx, glandulæ thyroideæ, and the musculus cutaneus, which really belong to the head; and therefore, instead of making a particular section for so small a number of parts, especially since the larynx and pharynx have so near a relation to the internal parts of the mouth, we are under a necessity of describing them, before proceeding to the mouth in particular.

The

The LARYNX.

The larynx forms the protuberance in the upper and anterior part of the neck, called commonly *pomum Adami*.

It is chiefly made up of five cartilages, *viz.* Cartilago thyroides, which is the anterior and largest; cricoides, the inferior, and basis of the rest; two arytenoides, the posterior and smallest; and the epiglottis, which is above all the rest. These cartilages are connected together by ligaments, and they have likewise muscles, glands, membranes, &c. belonging to them.

The cartilago thyroidæa is large and broad, and folded in such a manner as to have a longitudinal convexity on the foreside, and two lateral portions, which may be termed *alæ*. The upper part of its anterior middle portion is formed into an angular notch; the upper edge of each ala makes an arch; and, together with the middle notch, these two edges resemble the upper part of an ace of hearts.

The lower edge of each ala is more even, and the posterior edges of both are very smooth, being lengthened out both above and below by apophyses, which are named the *cornua* of the thyroid cartilage.

The cricoid cartilage resembles a thick, irregular ring, very broad on one side, and narrow on the other; or it may be compared to a small portion of a thick tube, cut horizontally at one end, and very obliquely at the other. It is distinguished into a basis and top, into an anterior, posterior, and two lateral sides. The basis is almost horizontal, when we stand; and to this the aspera arteria is connected; so that the cricoides may be looked upon as the upper extremity of the trachea.

The posterior portion of the cricoides is larger than the rest, and its posterior or convex side is divided by a longitudinal eminence or prominent line into distinct surfaces, for the insertion of muscles. The top is gently sloped above this prominent line, and terminates on each side by a kind of obtuse angle, formed between it and the oblique edge of each lateral portion of this cartilage.

The whole posterior side is distinguished into two lateral portions by two prominent lines, each of which runs down almost in a streight direction from the articular surface at the top, a little below the middle of this side, where it terminates in another articular line a little concave; and near these four articular surfaces there are small tubercles. The two superior surfaces are for the articulation of the cartilagines arytenoidææ; and the two inferior, for the articulation of the inferior cornua or appendices of the cartilago thyroides.

The cartilagines arytenoidææ are two small, equal, similar cartilages, which, joined together, resemble the spout of an ewer, and they are situated on the top of the cricoides. In each, we may consider the basis; cornua; two sides, one posterior and concave, the other anterior and convex; and two edges, one internal, the other external, which is very oblique. The bases are broad and thick, and have each a concave articular surface, by which they are joined to the cricoides.

The cornua are bent backward, and a little toward each other.

The epiglottis is an elastic cartilage, nearly of the figure of a purslain leaf, narrow and thick at the lower part, thin and slightly rounded at the upper part, gently convex on the foreside, and concave on the backside. It is situated above the anterior or convex portion of the cartilago thyroides; and its lower extremity is tied by a short, pretty broad, and very strong ligament, to the middle notch in the upper edge of that cartilage. It is perforated by a great number of holes, something like those in the leaves of the hypericum, or St John's Wort, which are hid by the membranes that cover its two sides.

The cartilago thyroides is connected to the cricoides by several short strong ligaments, round the articulations of the two inferior cornua, with the lateral articular surfaces of the cricoides. The apices of the superior cornua are fixed to the posterior extremities of the great cornua of the os hyoides, by slender, round ligaments, about a quarter of an inch in length.

The thyroides is likewise connected to the os hyoides by a short, broad, strong ligament, one end of which is inserted in the superior notch of the cartilage, and the other in the lower edge of the basis of the bone. It has also two ligaments at the middle of the concave side, which belong to the arytenoidææ.

The cricoides is tied to the lower part of the thyroides by a strong ligament; and by the ligaments already mentioned, to the inferior cornua of that cartilage. Its basis is fixed to the first cartilaginous ring of the trachea arteria, by a ligament exactly like those by which the other rings are connected together; and the membranous or posterior portion of the trachea is likewise fixed to the posterior part of the basis of the cricoides.

The cartilagines arytenoidææ are connected to the cricoides by ligaments, which surround their articulations with the top of that cartilage. Anteriorly the basis of each arytenoides is fixed to one end of a ligamentary cord, which by its other end is inserted about the middle of the concave side of the anterior portion of the thyroides. At their insertions in the thyroides, these two ligaments touch each other, but a small space is left between them, where they are fixed in the two arytenoides, and they seem likewise to have a small adhesion to the top of the cricoides. This is what is called the *glottis*.

Under these two ligamentary cords there are two others, which run likewise from behind forward. The interstice between the superior and inferior cords on each side form a transverse fissure, which is the opening of a small membranos bag, the bottom of which is turned outward, that is, toward the ala of the thyroides. These two sacculi are chiefly formed by a continuation of the internal membrane of the larynx, and the inner surface of their bottom appears sometimes to be glandulous.

On the anterior surface of the arytenoid cartilages, there is a small depression between the basis and the convex upper part. This depression is filled by a glandulous body, which not only covers the anterior surface of each arytenoides, but is likewise extended forward from the basis over the posterior extremity of the neighbouring ligamentary cord.

The

The epiglottis has likewife two lateral ligaments, by which it is connected to the arytenoides, all the way to their points or cornua. It has alfo a membranous ligament, which running along the middle of its anterior or concave fide, ties it to the root or bafis of the tongue. This ligament is only a duplicature of the membrane which covers the epiglottis, continued to the neighbouring parts. Laftly, there are two lateral membranous ligaments belonging to it, fixed near the glandulous bodies called *amygdalæ*.

The epiglottis is not only perforated by the regular holes already mentioned, but has likewife a great number of fmall irregular fciffures and breaks, which are fo many different lacunæ fituated between its two membranes, and filled with fmall glands, the excretory orifices of which are chiefly on the backfide of this cartilage.

The larynx gives infertion to a number of mufcles, which fhall now be defcribed.

The fterno-thyroidæi are two long, flat, narrow, thin mufcles, like ribbons, broader above than below, and fituated along that part of the neck which lies between the thyroid cartilage and the fternum. They are covered by the fterno-hyoidæi, and they cover the thyroid glands, paffing immediately before them.

Each mufcle is fixed, by its lower extremity, partly in the fuperior portion of the inner or backfide of the fternum, partly in the ligament and neighbouring portion of the clavicula, and partly in the cartilaginous portion of the firft rib. Sometimes it runs a great way down on the firft bone of the fternum, and croffes the mufcle on the other fide. From thence it runs up on the afpera arteria, clofe by its fellow, paffes before the thyroid glands, over the cricoid cartilage; and is inferted, by its upper extremity, in the lower part of the lateral fide of the thyroid cartilage, and partly along that whole fide.

The thyro-hyoidæi, or hyo-thyroidæi are two flat, thin mufcles, lying clofe by each other, between and above the former. Each of them is inferted, by its upper extremity, partly in the bafis, and partly in the neighbouring part of the great cornua of the os hyoides; and by its lower extremity, in the lower part of the lateral fide of the thyroid cartilage, immediately above the fuperior extremity of the fterno-thyroidæus; and both this fuperior extremity of the laft named mufcle, and the lower extremity of the thyro-hyoidæus, are, at their place of union, confounded a little with the thyro-pharyngæus inferior.

The crico-thyroidæi are two fmall mufcles, fituated obliquely at the lower part of the thyroid cartilage. They are inferted by their lower extremities in the anterior portion of the cricoid cartilage, near each other, and by their fuperior extremities, laterally in the lower edge of the thyroid cartilage, at a diftance from each other.

The two mufculi crico-arytenoidæi pofteriores are fituated pofteriorly at the large or back portion of the cricoides, filling almoft the two longitudinal furfaces of that portion, and diftinguifhed by the prominent line between thefe two furfaces. Each of them runs up obliquely, and is inferted, by its upper extremity, in the pofterior part of the bafis of the arytenoid cartilage of the fame fide, near the angle of that bafis.

The two crico-arytenoidæi laterales are fmall, and fituated more laterally than the former. Each mufcle is fixed by one end to the fide of the broad part of the cricoides, and by the other to the lower part of the fide of the neighbouring arytenoides.

The two thyro-arytenoidæi are very broad, each mufcle being fituated laterally between the thyroides and cricoides. It is fixed by a broad infertion in the infide of the ala of the thyroid cartilage; and the fibres contracting from thence, run from before backward, and from below upward, towards the neighbouring arytenoid cartilage, in which they are inferted, from the glottis to the angle of the bafis.

The arytenoidæi are fmall mufcles lying on the pofterior concave fides of the arytenoid cartilages, of which two are called *crucial arytenoidæi*, and one *tranfverfe*.

The crucial mufcles run each obliquely from the bafis of one arytenoid cartilage, to the middle and upper part of the other, the left mufcle covering the right.

The arytenoidæus tranfverfalis is inferted more or lefs directly, by both extremities, in the two arytenoid cartilages.

The two thyro-epiglottici crofs the thyro-arytenoidæi, being inferted in the inner lateral part of the thyroides, and laterally in the epiglottis.

The aryteno-epiglottici are fmall flefhy fafciculi, each of which is fixed by one extremity in the head of one of the arytenoid cartilages, and by the other in the neareft edge of the epiglottis.

The larynx ferves particularly to admit and let out the matter of refpiration; and the folidity of the pieces of which it is compofed hinders not only external objects, but alfo any hard thing which we fwallow, from difordering this paffage. The glottis, being a narrow flit, modifies the air which we breathe; and as it is very eafily dilated and contracted, it forms the different tones of the voice, chiefly by means of the different mufcles inferted in the cartilagines arytenoidææ, to which the other mufcles of the larynx are affiftants.

The whole larynx is likewife of ufe in deglutition, by means of its connection with the os hyoides, to which the digaftric mufcles of the lower jaw adhere; which mufcles raife the larynx together with the os hyoides every time we fwallow.

The facility of varying and changing the tone of the voice, depends on the flexibility of the cartilages of the larynx, and decreafes in proportion as we advance in age, becaufe thefe cartilages gradually harden and offify.

The mufculi fterno-thyroidæi ferve in general to pull down the thyroid cartilage, and the whole larynx along with it. The thyro-hyoidæi may, as occafion requires, either draw up the larynx toward the os hyoides, or draw that bone downward toward the cartilago thyroides.

It is difficult to determine the ufe of the crico-thyroidæi from their fituation. They may either pull the cricoides obliquely backward, or the thyroides obliquely forward.

Both the lateral and pofterior crico-arytenoidæi, may feparate the arytenoid cartilages, and thereby open or dilate the glottis.

The thyro-arytenoidæi acting together, draw both the arytenoid

arytenoid cartilages forward, and confequently loofen the glottis, and render it capable of the fmalleft quaverings of the voice.

The arytenoidæi bring the arytenoid cartilages clofe together, and prefs them againft each other; and when the cartilages are in this fituation, they may at the fame time be inclined either forward by the thyro-arytenoidæi, or backward by the crico-arytenoidæi pofteriores. By this means the glottis, when fhut, may be either relaxed or tenfe; and in this laft cafe it is intirely fhut, as when we hold in our breath in ftraining.

The general ufe of the epiglottis is to cover the glottis like a pent-houfe, and thereby hinder any thing from falling into it when we eat or drink; it ferves likewife to hinder the air which we infpire from rufhing directly upon the glottis, but by fplitting it, as it were, obliges it to enter by the fides, or in an oblique courfe. The mufcles of the epiglottis do not appear to be abfolutely neceffary for that cartilage; for in deglutition, it may be fufficiently depreffed by the bafis of the tongue; and it may raife itfelf again by its own elafticity. The thyro-epiglottici and aryteno-epiglottici may ferve to fhut any lateral openings that might remain when the epiglottis is depreffed by the bafis of the tongue; and the hyo-epiglottici may pull it a little forward in ftrong refpirations, as in fighing, yawning, &c.

The PHARYNX.

The pharynx is a mufcular and glandular bag, the outer furface of which is clofely joined to the inner furface of all that fpace which is at the bottom of the mouth, behind the pofterior nares, uvula, and larynx, and which reaches from the great or anterior apophyfis of the os occipitis all the way to the œfophagus, which is the continuation of the pharynx.

Though almoft all the mufcular or flefhy portions of which the pharynx is compofed, concur in the formation of one continued bag or receptacle, they are neverthelefs very diftinguifhable from each other, not only by their different infertions, from which they have been denominated, but alfo by the different directions of their fibres. The greateft part of them may be looked upon as digaftric mufcles, the middle tendons of which lie backward in one longitudinal line, which in fome fubjects appears plainly like a linea alba.

The cephalo-pharyngæi are inferted in the lower fide of the apophyfis bafiliaris, or great apophyfis of the os occipitis, about the middle of the pofterior part. From thence they feparate laterally, and fometimes join the ftylo-pharyngæi. The linea alba of the pharynx begins by the middle adhefion of thefe mufcles.

The petro-pharyngæi are inferted in the lower part of the extremity of the apophyfis petrofa; the fpheno-pharyngæi, partly in the os fphenoides, directly above the internal ala of the apophyfis pterygoides, and partly in the neighbouring cartilaginous portion of the Euftachian tube; and the pterygo-pharyngæi, in the edge of the fame ala of the apophyfis pterygoides. Thefe three mufcles on each fide run obliquely backward, covering each other by fome fibres, and meet at the linea alba. Their ufe may be to draw the middle portion or great cavity of the pharynx upward.

The ftylo-pharyngæi are inferted interiorly by one extremity in the apophyfis, or epiphyfis ftyloides. From thence each mufcle runs down obliquely along the lateral part of the pharynx, covering and croffing the other mufcles. It extends gradually in breadth as it defcends, and forms two principal portions, one fuperior which is narrow, and one inferior which is broad. The narrow portion is fpread among the mufcular fibres above the thyroid cartilage, and the broad portion is inferted in the fide of that cartilage; and thus the ftylo-pharyngæus is partly a true ftylo-thyroidæus. Thefe mufcles may draw the pharynx laterally upward, efpecially by their thyroid portions.

The peryftaphylo-pharyngæi are two fmall mufcles inferted between the uvula and lower extremity of the internal ala of the apophyfis pterygoides, and run obliquely backward on the fides of the pharynx. The gloffo-pharyngæi are fibres which run along the lateral edges of the tongue, from which they are parted backward, and run down on the fides of the pharynx under the ftylo-pharyngæi.

The hyo-pharyngæi in general are thofe on each fide which are inferted in the os hyoides; and they may be reckoned three pairs, the bafio-pharyngæi, kerato-pharyngæi minores, and kerato-pharyngæi majores; thefe denominations being taken from their infertions in the bafis, and in the fmall and great cornua of the os hyoides.

The mylo-pharyngæi is a mufcular portion diftinct from the genio-gloffus, inferted in the fide of the pharynx.

The fyndefmo-pharyngæi are fafciculi of mufcular fibres very diftinctly inferted by one end along the ligaments by which the fuperior cornua of the cartilago thyroides are connected to the extremities of the great cornua of the os hyoides. From thence they run backward and meet at the linea alba.

The thyro-pharyngæi are very broad, and each mufcle is inferted along the outfide of the ala of the cartilago thyroides, between the edge of that cartilage and the oblique line in which the thyro-hyoidæi are fixed From thence they run up obliquely backward, and meet under the linea alba.

The crico-pharyngæi are inferted each in the lower part of the fide of the cricoid cartilage. They feem to be appendices of the thyro-pharyngæi, fhewing no other marks of diftinction but thefe infertions, and a fmall difference in direction, becaufe as they run backward they defcend a little.

The loweft of thefe mufcular fibres make a complete circle backward, between the two fides of the bafis of the cartilago cricoides. This circle is the beginning of the œfophagus, and has been thought by fome to form a diftinct mufcle, called *œfophagæus*.

The particular ufes of all thefe mufcles are very difficult to be determined. It is certain that thofe of the middle and lower portions of the pharynx ferve chiefly for deglutition.

The PALATE, UVULA, &c.

The palate is that arch or cavity of the mouth, surrounded anteriorly by the alveolary edge and teeth of the upper jaw, and reaching from thence to the great opening of the pharynx. This arch is partly solid and immoveable, and partly soft and moveable. The solid portion is that which is bounded by the teeth, being formed by the two offa maxillaria, and two offa palati. The soft portion lies behind the other, and runs backward like a veil fixed to the edge of the offa palati, being formed partly by the common membrane of the whole arch, and partly by feveral mufcular fafciculi, &c.

The membrane that covers all this cavity is like that which lines the fuperior and middle portions of the pharynx. It is very thick fet with fmall glands, the orifices of which are not fo fenfible as in the pharynx, and efpecially in the rugæ of the fuperior portion thereof.

This membrane, together with that of the pofterior nares, forms, by an uninterrupted continuation, the anterior and pofterior furface of the foft portion, or feptum palati; fo that the mufcular fafciculi of this portion lie in the duplicature of a glandulous membrane.

The feptum, which may likewife be termed *velum*, or *valvula palati*, terminates below by a loofe floating edge, reprefenting an arch fituated tranfverfely above the bafis or root of the tongue. The higheft portion or top of this arch fuftains a fmall, foft, and irregularly conical glandulous body, fixed by its bafis to the arch, and its apex hanging down without adhering to any thing, which is called *uvula*.

On each fide of the uvula there are two mufcular half arches, called *columnæ fepti palati*. They are all joined to the uvula by their upper extremities, and difpofed in fuch a manner, as that the lower extremities of the two which lie on the fame fide are at a little diftance from each other, and fo as that one half-arch is anterior, the other pofterior, an oblong triangular fpace being left between them, the apex of which is turned toward the bafis of the uvula.

The two half arches on one fide, by joining the like half arches on the other fide, form the entire arch of the edge of the feptum. The pofterior half arches run, by their upper extremities, more directly toward the uvula than the anterior. The anterior half arches have a continuation with the fides of the bafis of the tongue, and the pofterior with the fides of the pharynx. At the lower part of the fpace left between the lateral half arches on the fame fide, two glands are fituated, termed *amygdalæ*.

The half arches are chiefly made up of feveral flat flefhy portions, almoft in the fame manner with the body of the feptum. The membrane which covers them is thinner than the other parts of it towards the palate, pharynx, and tongue. Each portion is a diftinct mufcle, the greateft part of which terminate by one extremity in the fubftance of the feptum and of the half arches, and by the other extremity in parts different from thefe.

As anatomifts ufed formerly to afcribe all thefe mufcles, as far as they knew them, to the uvula, without any regard to the feptum, they termed them in general either *ptery-ftaphylini*, or *peri-ftaphylini*.

The gloffo-ftaphylini are two fmall mufcles, fixed each in the lower and lateral part of the bafis of the tongue; from whence they run up obliquely backward along the anterior half arches of the feptum palati, and terminate infenfibly on each fide near the uvula, fome of their fibres being fpread through the feptum.

The pharyngo-ftaphylini are likewife two fmall mufcles, each of them being fixed by one extremity to the lateral part of the mufculi thyro-pharyngæi, as if they were portions detached from thefe mufcles. From thence they run up obliquely forward along the two pofterior half arches of the feptum, and terminate in the feptum above the uvula, where they meet together, and feem to form an entire arch by the union of their fibres.

The thyro-ftaphylini are two fmall mufcles, which accompany the pharyngo-ftaphylini very clofely, through their whole courfe, except that their pofterior extremities are fixed in the thyroid cartilages near the other mufcles. They are inferted in the feptum in the fame manner with the former.

The fpheno-falpingo-ftaphylini are each fixed by one extremity, partly to the fphenoidal fide of the bony portion of the Euftachian tube, partly to the neareft foft portion of the fame tube. From thence it runs toward the external ala of the apophyfis pterygoides, into which one portion of this mufcle is inferted. The other portion runs to the end of the ala, and turns round to the forked extremity thereof, as over a pulley, and is afterwards inferted in the feptum palati, near the uvula.

The pterygo-ftaphylinus fuperior is fo named becaufe it has a fmall infertion in the upper part of the apophyfis pterygoides, befides that in the fphenoidal part of the bony portion of the tube. The pterygo-ftaphylinus inferior on each fide, is a fmall mufcle, inferted by one extremity in the uncus pterygoidæus, and by the other in the feptum near the uvula.

The petro-falpingo-ftaphylini, or falpingo ftaphylini interni, are thofe which are commonly called *peri-ftaphylini interni*. Each mufcle is fixed by one extremity, partly to the inner fide of the bony portion of the Euftachian tube, or that next the apophyfis petrofa, partly along the cartilaginous portion of the fame tube. From thence it paffes a little way under the foft membranous part, and then, turning toward the feptum, is fixed in the edge, and partly in the upper fide thereof.

The ftaphylini, or epiftaphylini, are two fmall flefhy ropes, clofely united together, as if they made but one mufcle. They are fixed by one extremity in the common point of the pofterior edges of the offa palati, and from thence run downward and backward along the middle of the feptum, and likewife along the middle of almoft the whole uvula. Thefe mufcles have been termed *azygos Morgagnii*, from the difcoverer, but he confidered them as one mufcle. The pterygo-ftaphylini inferiores are of the fame kind, and might be termed *ftaphylini*, or *epiftaphylini laterales*, and thefe laft, *medii*.

The feptum palati ferves to conduct the lachrymal lympha, and that which is continually collected on the arch of the palate, into the pharynx. It ferves for a valve

valve to hinder what we ſwallow, and eſpecially what we drink, from returning by the nares. The uſes of the different muſcles of the ſeptum are not as yet ſufficiently known, nor the different motions of which it is capable.

The TONGUE.

The tongue is divided into the baſis and point; the upper and under ſides; and the lateral portions or edges. The baſis is the poſterior and thickeſt part; the point, the anterior and thinneſt part. The upper ſide is not quite flat, but a little convex, and divided into two lateral halves, by a ſhallow depreſſed line, called *linea linguæ mediana*. The edges are thinner than the other parts, and a little rounded as well as the point. The lower ſide reaches only from the middle of the length of the tongue to the point.

The tongue is principally compoſed of very ſoft fleſhy fibres, intermixed with a particular medullary ſubſtance, and diſpoſed in various manners. Many of theſe fibres are confined to the tongue without going any farther, the reſt form ſeparate muſcles which go out from it in different ways, and are inſerted in other parts. All the upper ſide of the tongue is covered by a thick membrane of a papillary texture, upon which lies another very fine membrane like a kind of epidermis, which is likewiſe continued over the lower ſide, but without papillæ.

Three ſorts of papillæ may be diſtinguiſhed in the upper ſide of the tongue, capitatæ, ſemi-lenticulares, and villoſæ. Thoſe of the firſt kind are the largeſt, reſembling little muſhrooms with ſhort ſtems, or buttons without a neck. They lie on the baſis of the tongue in ſmall ſuperficial foſſulæ.

They reſemble ſmall conglomerate glands ſeated on a very narrow baſis, and each of them has ſometimes a ſmall depreſſion in the middle of their upper or convex ſide. They occupy the whole ſurface of the baſis of the tongue. They are glandular papillæ, or ſmall ſalival or mucilaginous glands.

We oftentimes obſerve, about the middle of this part of the tongue, a particular hole of different depths, the inner ſurface of which is entirely glandular, and filled with ſmall papillæ, like thoſe of the firſt kind. It is called *foramen cæcum Morgagnii*, as being firſt deſcribed by that author. Since that time M. Vaterus has diſcovered a kind of ſalival ducts belonging to it; and M. Heiſter found two of theſe ducts very diſtinctly, the orifices of which were in the bottom of the foramen cæcum near each other. He obſerved the ducts to run backward, divaricating a little from each other, and that one of them terminated in a ſmall oblong veſicle ſituated on the ſide of the ſmall cornu of the os hyoides.

The papillæ of the ſecond kind, or ſemi-lenticulares, are ſmall orbicular eminences, only a little convex, their circular edge not being ſeparate from the ſurface of the tongue. When we examine them in a ſound tongue, with a good microſcope, we find their convex ſides full of ſmall holes or pores, like the end of a thimble.

They lie chiefly in the middle and anterior portions of the tongue, and are ſometimes moſt viſible on the edges, where they appear to be very ſmooth and poliſhed, even to the naked eye.

The papillæ of the third kind, or villoſæ, are the ſmalleſt and moſt numerous. They fill the whole ſurface of the upper ſide of the tongue, and even the interſtices between the other papillæ.

The fleſhy fibres of which the tongue is compoſed, and which go no further than the tongue, may be termed *muſculi linguæ interiores*; and they are the ſame which Spigelius named *muſculi linguales*. The fibres theſe muſcles conſiſt of are of three general kinds, longitudinal, tranſverſe, and vertical; and each of theſe ſituations admits of different degrees of obliquity. The longitudinal fibres point to the baſis and apex of the tongue, and ſeem partly to be expanſions of the muſculi ſtylo-gloſſi, hyo-gloſſi, and genio-gloſſi; of which hereafter. The vertical fibres ſeem likewiſe to be in part produced by the ſame genio-gloſſi, and the tranſverſe by the mylo-gloſſi.

The muſculi exteriores are four in number, and make a part of the body of the tongue.

The mylo-gloſſi are ſmall fleſhy planes, ſituated tranſverſely, one on each ſide, between the ramus of the lower jaw, and the baſis of the tongue. Their inſertion in the jaw is immediately above the poſterior half of the mylo-hyoidæus, between the prominent oblique line on the inſide of the bone, and the dentes molares. From thence they run toward the baſis of the tongue, and are loſt there on one ſide of the gloſſo-pharyngæi.

The ſtylo-gloſſi are two long ſmall muſcles which run down from the ſtyloid apophyſes, or epiphyſes, and form two portions of the lateral parts of the tongue. Each muſcle is fixed in the outſide of the apophyſis ſtyloides by a long tendon. The ſtylo-hyoidæus is the loweſt, and the ſtylo-pharyngæus is in the middle, but more backward.

As it runs down almoſt oppoſite to the inſide of the angle of the lower jaw, it ſends off a pretty broad and ſhort lateral aponeurotic ligament, which being fixed in that angle ſerves for a frænum, or ligamentum ſuſpenſorium, to the muſcle in this part of its courſe. From thence it paſſes on to the ſide of the baſis of the tongue, where it firſt of all adheres cloſely to the lateral portion of the hyo-gloſſus, and then forms, together with that muſcle, a large portion of the ſide of the tongue.

The hyo-gloſſi are each inſerted in three parts of the os hyoides that lie near each other, in the baſis, in the root of the great cornu, and in the ſymphyſis between theſe two; and on this account the hyo-gloſſus has been divided by ſome into two or three diſtinct muſcles, called *baſio-gloſſus*, *cerato-gloſſus*, and *chondro-gloſſus*.

It is ſituated on the inſide, and a little lower than the ſtylo-gloſſus, with which it forms the lateral part of the tongue. The portion inſerted in the baſis of the os hyoides lies more anteriorly, and is larger than the other two; that which is inſerted in the ſymphyſis is the leaſt, and that inſerted in the great cornu the moſt poſterior. This muſcle is partly ſuſtained by the mylo-hyoidæus, as by a girth; and the anterior portion is diſtinguiſhed from the reſt by the paſſage of the nerves of the fifth pair, and of the arteries which accompany them.

The genio-gloſſi are ſituated cloſe to each other on the lower

ſome of them lie very near the ſkin, and the reſt at a greater diſtance from it.

As theſe lymphatic glands differ more in ſituation than in ſize or figure, they are commonly enumerated and denominated from the places where they lie; *e. g.*

Glandulæ parotides lymphaticæ,
Glandulæ maxillares lymphaticæ,
Glandulæ jugulares, *&c.*

The lymphatic veſſels were diſcovered more than an hundred years ago. But their nature and origin were not underſtood till Dr Alexander Monro, preſent Profeſſor of Anatomy in the Univerſity of Edinburgh, publiſhed his treatiſe, *De Venis Lymphaticis Valvuloſis*, in the year 1757. In this treatiſe the Doctor has proved, by many accurate experiments, That the lymphatic veſſels are a ſyſtem of abſorbents: That they are not continuations of the arteries or veins; but that they are a diſtinct ſyſtem of veſſels, deſtined for abſorbing a pellucid liquor called *lymph*, from the different cavities of the body, *&c.* and for tranſmitting it to the blood, by the contraction of their coats, and the preſſure of the neighbouring parts.

Beſides theſe veſſels which accompany the glands, there are others of the ſame ſtructure found on the ſeveral viſcera, where no lymphatic glands have hitherto been diſcovered. We meet with them in very great numbers in the external membrane of the liver, and in the duplicature of the ſuperior membranous ligament of this viſcus.

Another ſort of veſſels termed *lymphatics*, are the ſmall arteries and veins, which, in the natural ſtate, tranſmit only the ſerous part of the blood. Theſe veſſels differ from the abſorbent lymphatics in the ſmallneſs of their diameter, and in their ſtructure and ſituation. All theſe little arteries and veins are uniform, extremely narrow; and though their ſides are not thinner than thoſe of the valvular lymphatics, yet their diameters are generally leſs. The other lymphatics are full of valves, and very thin, but they are not narrow in proportion. The arterial and venal lymphatics are found on the parts which are naturally white, as on the ſkin, the white of the eye, *&c.*

EXPLANATION OF PLATE XXI.

FIGURE 1. Shews the lachrymal canals, after the common teguments and bones have been cut away.

a, The lachrymal gland. b, The two puncta lachrymalia, from which the two lachrymal canals proceed to c, the lachrymal ſac. d, The large lachrymal duct. e, Its opening into the noſe. f, The caruncula lachrymalis. g, The eye ball.

FIG. 2. An anterior view of the coats and humours of the eye.

a a a a, The tunica ſclerotica cut in four angles, and turned back. b b b b, The tunica choroides adhering to the inſide of the ſclerotica, and the ciliary veſſels are ſeen paſſing over—c c, The retina, which covers the vitreous humour. d d, The ciliary proceſſes, which were continued from the choroid coat. e e, The iris. f, The pupil.

FIG. 3. Shews the optic nerves, and muſcles of the eye.

a a, The two optic nerves before they meet. b, The two optic nerves conjoined. c, The right optic nerve. d, Muſculus attollens palpebræ ſuperioris. e, Attollens oculi. f, Abductor. g g, Obliquus ſuperior, or trochlearis. h, Adductor. i, The eye-ball.

FIG. 4. Shews the eye-ball with its muſcles.

a, The optic nerve. b, Muſculus trochlearis. c, Part of the os frontis, to which the trochlea or pulley is fixed, through which,—d, The tendon of the trochlearis paſſes. e, Attollens oculi. f, Adductor oculi. g, Abductor oculi. h, Obliquus inferior. i, Part of the ſuperior maxillary bone to which it is fixed. k, The eye-ball.

FIG. 5. Repreſents the nerves and muſcles of the right eye, after part of the bones of the orbit have been cut away.

A, The eye-ball. B, The lachrymal gland. C, Muſculus abductor oculi. D, Attollens. E, Levator palpebræ ſuperioris. F, Depreſſor oculi. G, Adductor. H, Obliquus ſuperior, with its pulley. I, Its inſertion into the ſclerotic coat. K, Part of the obliquus inferior. L, The anterior part of the os frontis cut. M, The cryſta galli of the ethmoid bone. N, The poſterior part of the ſphenoid bone. O, Tranſverſe ſpinous proceſs of the ſpenoid bone. P, The carotid artery, denuded where it paſſes thro' the bones. Q, The carotid artery within the cranium. R, The ocular artery.

NERVES.—a a, The optic nerve. b, The third pair.—c, Its joining with a branch of the firſt branch of the fifth pair, to form l, The lenticular ganglion, —which ſends off the ciliary nerves, d. e e, The fourth pair. f, The trunk of the fifth pair. g, The firſt branch of the fifth pair, named ophthalmic.—h, The frontal branch from it. i, Its ciliary branches, along with which the naſal twig is ſent to the noſe. k, Its branch to the lachrymal gland. l, The lenticular ganglion. m, The ſecond branch of the fifth pair, named ſuperior maxillary. n, The third branch of the fifth pair, named inferior maxillary. o, The ſixth pair of nerves,—which ſends off p, The beginning of the great ſympathetic. q, The remainder of the ſixth pair, ſpent on c, The abductor oculi.

FIG. 6. Repreſents the head of a youth, where the upper part of the cranium is ſawed off,—to ſhew the upper part of the brain, covered by the pia mater, the veſſels of which are minutely filled with wax.

A A, The cut edges of the upper part of the cranium.

B, The two tables and intermediate diploe. B B, The two hemifspheres of the cerebrum. C C, The incifure made by the falx. D, Part of the tentorium cerebello fuper expanfum. E, Part of the falx, which is fixed to the crifta galli.

FIG. 7. Reprefents the parts of the external ear, with the parotid gland and its duct.

a a, The helix. b, The anthelix. c, The antitragus. d, The tragus. e, The lobe of the ear. f, The cavitas innominata. g, The fcapha. h, The concha. i i, The parotid gland. k, A lymphatic gland, which is often found before the tragus. l, The duct of the parotid gland. m, Its opening into the mouth.

FIG. 8. A view of the pofterior part of the external ear, meatus auditorius, tympanum, with its fmall bones, and Euftachian tube of the right fide.

a, The back part of the meatus, with the fmall ceruminous glands. b, The incus. c, Malleus. d, The chorda tympani. e, Membrana tympani. f, The Euftachian tube. g, Its mouth, from the fauces.

FIG. 9. Reprefents the anterior part of the right external ear, the cavity of the tympanum—its fmall bones, cochlea, and femi-circular canals.

a, The malleus. b, Incus with its long leg, refting upon the ftapes. c, Membrana tympani. d, e, The Euftachian tube, covered by part of—f f, The mufculus circumflexus palati. 1, 2, 3, The three femicircular canals. 4, The veftible. 5, The cochlea. 6, The portio mollis of the feventh pair of nerves.

FIG. 10. Shews the mufcles which compofe the flefhy fubftance of the tongue.

a a, The tip of the tongue, with fome of the papillæ minimæ. b, The root of the tongue. c, Part of the membrane of the tongue, which covered the epiglottis. d d, Part of the mufculus hyo-gloffus. e, The lingualis. f, Genio-gloffus. g g, Part of the ftylogloffus.

ANATOMY is alfo ufed, in a lefs proper fenfe, for the analyfing of compound bodies. See ANALYSIS.

ANATOMY, in fome old ftatutes, is ufed to denote the fubject to be anatomized.

ANATOMY, in a figurative fenfe, is fometimes ufed for a ftrict examination of an affair, difcourfe, or performance.

ANATOMY *of plants*. See AGRICULTURE, Part I.

ANATORIA, a fmall city of Greece, upon the river Afopa, five miles from the ftraits of Negropont.

ANATRON, NATRON, or NATRUM, in natural hiftory. See NATRUM.

ANAUDIA, a term ufed by fome writers to denote dumbnefs, or the want of the ufe of fpeech.

ANAXAGORIA, in Grecian hiftory, an anniverfary feftival, kept, in honour of Anaxagoras, by the people of Lampfacus.

ANAXIMANDRIANS, in the hiftory of philofophy, the followers of Anaximander; the moft ancient of the philofophical atheifts, who admitted of no other fubftance in nature but matter.

ANAZZO, a town in the province of Barri, in the kingdom of Naples.

ANBAR, a city of Afia, fituated upon the Euphrates, twenty leagues from Bagdat. It is called by the natives *Hafchemiah*.

ANBURY, among farriers. See AMBURY.

ANCAMARES, a people of S. America. along the river Madeira, which afterwards falls into the river of the Amazons.

ANCARANO, a fmall city of the ecclefiaftical ftate, in the marquifate of Ancona.

ANCASTER, a town of Lincolnfhire, near Lincoln, W. long. 30′. N. lat. 52° 50′.

ANCENIS, a town of France, in the province of Britanny, W. long. 1° 9′. N. lat. 47° 20.

ANCESTORS, thofe from whom a perfon is defcended in a ftreight line.

ANCESTREL, in law, fomething that relates to, or has been done by one's anceftors.

ANCHIALUS, a city of Thrace, upon the Euxine fea, by the Turks called *Kipkis*, and by the Greeks *Anchio*.

ANCHILOPS, in medicine, a fmall tumor in the great angle of the eye, frequently degenerating into an abcefs or fiftula lachrymalis.

ANCHIO, in geography. See ANCHIALUS.

ANCHOR, in maritime affairs, an extremely ufeful inftrument, ferving to retain a fhip in its place.

It is a very large and heavy iron inftrument, with a double hook at one end, and a ring at the other, by which it is faftened to a cable. It is caft into the bottom of the fea, or rivers; when, taking its hold, it keeps fhips from being drawn away by the wind, tide, or currents.

The parts of an anchor are, 1. The ring to which the cable is faftened. 2. The beam or fhank, which is the longeft part of the anchor. 3. The arm, which is that which runs into the ground. 4. The flouke or fluke, by fome called the *palm*, the broad and peaked part, with its barbs, like the head of an arrow, which faftens into the ground. 5. The ftock, a piece of wood faftened to the beam near the ring, ferving to guide the fluke, fo that it may fall right and fix in the ground.

There are feveral kinds of anchors: 1. The fheet-anchor, which is the largeft, and is never ufed but in violent ftorms, to hinder the fhip from being driven a-fhore.

a-ſhore. 2. The two bowers, which are uſed for ſhips to ride in a harbour. 3. The ſtream anchor. 4. The grapnel. See STREAM-ANCHOR, *and* GRAPNEL.

The ſhank of an anchor is to be three times the length of one of its flukes; and a ſhip of 500 tons hath her ſheet-anchor of 2000 weight; and ſo proportionably for others, ſmaller or greater. The anchor is ſaid to be *a-peak*, when the cable is perpendicular between the hawſe and the anchor. See HAWSE.

An anchor is ſaid to *come home*, when it cannot hold the ſhip. An anchor is *foul*, when, by the turning of the ſhip, the cable is hitched about the fluke. To *ſhoe* an anchor, is to fit boards upon the flukes, that it may hold the better in ſoft ground. When the anchor hangs right up and down by the ſhip's ſide, it is ſaid to be a *cock-bell*, upon the ſhip's coming to an anchor.

The inhabitants of Ceylon uſe large ſtones inſtead of anchors; and in ſome other places of the Indies, the anchors are a kind of wooden machines, loaded with ſtones.

ANCHOR, in architecture, a ſort of carving, ſomething reſembling an anchor. It is commonly placed as part of the enrichments of the boultins of capitals of the Tuſcan, Doric, and Ionic orders; and alſo of the the boultins of bed-mouldings of the Doric, Ionic, and Corinthian cornices; anchors and eggs being carved alternately through the whole building.

ANCHOR, in heraldry, are emblems of hope, and are taken for ſuch in a ſpiritual, as well as a temporal ſenſe.

ANCHORAGE, or ANCHORING-GROUND, a place where a ſhip may caſt anchor.

The beſt anchoring-ground is ſtiff clay or hard ſand; and the beſt place for riding at anchor is, where a ſhip is land-locked, and out of the tide.

ANCHORAGE, in law, is a duty upon ſhips for the uſe of the port or harbour where they caſt anchor.

ANCHORALIS *proceſſus*. See CORACOIDES.

ANCHORED, or ANKERED, is ſaid of a croſs, the four extremities of which reſemble the flukes of an anchor.

The croſs reſembles very much the croſs-moline; the whole difference between them conſiſting only in this, that the anchored croſs is ſomewhat ſharper at the points than the moline. See MOLINE.

ANCHOVY, in ichthyology, the Engliſh name of the clupea encraſicolus. See CLUPEA.

ANCHUSA, or ALKANET, in botany, a genus of the pentandria monogynia claſs. The corolla is ſhaped like a tunnel. There are eight ſpecies of the anchuſa; *viz.* 1. The officinalis, a native of France and the warmer parts of Europe. The root of the officinalis is not now uſed in medicine; its principal uſe is for colouring oils, unguents, plaſters, *&c.* 2. The anguſtifolia, a native of Italy and Germany. 3. The undulata, a native of Spain. 4. The orientalis, a native of the E. Indies. 5. The virginiana, a native of Virginia. 6. The lanata, a native of Algiers. 7. The tinctoria, a native of Montpelier. 8. The ſempervirens, or ever-green alkanet, a native of Britain and Spain.

ANCHYLOBLEPHARON, among phyſicians, denotes a coheſion of the eye-lids.

ANCIENT. See ANTIENT, and ANTIQUITY.

ANCIENTLY, in ſome old ſtatutes, a term uſed to denote ſeniority.

ANCLABRIS, in Roman antiquity, the table whereon the prieſts eat their portion of the ſacrifices.

ANCLAM, a town of Pomerania in Germany, ſituated on the river Pene, in E. long. 14°, and N. lat. 54°, about 45 miles N. W. of Stetin.

ANCLE, in anatomy. See TALUS.

ANCOBER, or RIO-COBRE, a river on the coaſt of Guinea in Africa.

ANCILIA, in antiquity. See ANCYLE.

ANCON. See OLECRANON.

ANCONA, a ſea-port town of Italy, ſituated on the gulph of Venice, in E. long. 15°, and N. lat. 43° 20′. It is the capital of a marquiſate of the ſame name, ſubject to the pope.

ANCONÆUS, in anatomy, one of the muſcles of the elbow. See ANATOMY, p. 197.

ANCONES, in architecture, the corners or coins of walls, croſs-beams, or rafters.

ANCONY, in mineralogy, denotes a bloom of iron faſhioned into a flat bar about three feet long, with a ſquare rough knot at each end.

ANCRE, a town of Picardy in France, upon a river of the ſame name, between Corbic and Bapaame.

ANCRE'E, in heraldry, the ſame with anchored. See ANCHORED.

ANCUAH, a city of the province of Alovahat, in the northern parts of Egypt.

ANCUBITUS, among ancient phyſicians, a term to denote that affection of the eyes in which they ſeemed to contain ſand.

ANCUD, a province of Chili in S. America, having on the weſt the Archipelago of the ſame name; the Andes on the eaſt; the country of Oſorno on the north; and the country of Magellan on the ſouth.

ANCYLE, in antiquity, a kind of ſhield that fell, as was pretended, from heaven, in the reign of Numa Pompilius; at which time, likewiſe, a voice was heard, declaring that Rome ſhould be miſtreſs of the world as long as ſhe ſhould preſerve this holy buckler. It was kept with great care in the temple of Mars, under the direction of twelve prieſts; and leſt any ſhould attempt to ſteal it, eleven others were made ſo like, as not to be diſtinguiſhed from the ſacred one. Theſe ancylia were carried in proceſſion every year round the city of Rome.

ANCYLE, in ſurgery, a diſtortion of the joints.

ANCYLOGLOSSUM, among phyſicians, denotes a contraction of the ligaments of the tongue, hindering ſpeech.

ANCYLOMELE, a ſurgeon's crooked probe. See PROBE.

ANCYLOSIS, in ſurgery. See ANCYLE.

ANCYROIDES, among anatomiſts. See CORACOIDES.

ANCZAKRICH, a river of Podolia, which falls into the Black Sea, near Oczakow.

ANDABATÆ, in antiquity, a fort of gladiators who, mounted on horfeback or in chariots, fought hoodwinked, having a helmet that covered their eyes.

ANDALUSIA, the moft fouth-weft province of Spain, having Eftremadura and New Caftile on the north; and Granada, the Straits of Gibraltar, and the Atlantic Ocean, on the fouth.

New ANDALUSIA, a province of Terra Firma, lying on the coaft of the Atlantic Ocean, oppofite to the Leeward iflands, having the river Oroonoco on the weft.

ANDAMAN, the name of fome fmall iflands fituated on the eaft fide of the entrance of the bay of Bengal, in E. long. 92°, and N. lat. 15°.

ANDANAGAR, a town of the peninfula in India, on this fide the Ganges, in the kingdom of Decan.

ANDANCE, a town of Languedoc in France, fituated near the confluence of the Rhone and the Dome.

ANDANTI, in mufic, fignifies, efpecially in thorough-baffes, that the notes are to be played diftinctly.

ANDAYE, a town in France, upon the Spanifh frontiers, within two leagues of St Jean de Luz.

ANDELI, a town of Normandy in France, fituated upon the Seine, between Paris and Rouen.

ANDENA, in old writers, denotes the fwath made in mowing of hay, or as much ground as a man could ftride over at once.

ANDENES, an ifland in the north fea, upon the coaft of Norway. It is only inhabited by fifhermen.

ANDERENÆ *fal*, a name fometimes ufed for the natrum of the ancients. See NATRUM.

ANDERLECHT, a fortrefs of the Auftrian Netherlands, about two miles fouth of Bruffels.

ANDERNACHT, a city of Germany, fituated on the Lower Rhine, in E. long. 7°, and N. lat. 50° 25′, about 30 miles fouth of Cologne.

ANDERO, a fea-port town of Spain, in the province of Bifcay, about fixty miles weft of Bilboa, fituated in W. long. 4° 30′, and N. lat. 43° 20′. Here the Spaniards build and lay up fome of their men of war.

ANDES, a vaft ridge of mountains which runs almoft the whole length of S. America. They are efteemed the higheft in the world, being covered with fnow in the warmeft climates; and from thence called the *Sierras Nivada*, or the *fnowy mountains*.

ANDEVALLO, a fmall country of Spain, in Andalufia, upon the frontiers of Portugal and Spanifh Eftremadura.

ANDEUSE, a city of Languedoc in France, fituated in E. long. 3° 40′, and N. lat. 43° 45′.

ANDORINHA, in ornithology, an obfolete name of the hirunda. See HIRUNDA.

ANDOVER, a large market-town in Hampfhire, fituated about ten miles north-weft of Winchefter, in W. long. 1° 30′, and N. lat. 51° 20′. It fends two members to parliament.

ANDRACHNE, in botany, a genus of the monœcia gynandria clafs. The calix of the male confifts of five leaves; the corolla has five petals; and the ftamina, which are alfo five in number, are inferted into the ftylus. The calix of the female is divided into five leaves; it has no corolla; the ftyli are three; the capfule is trilocular, containing two feeds. There are only two fpecies of the andrachne, *viz.* the telepheoides, a native of Italy; and the fruticofa, a native of China.

ANDREJOS, a town fituated near the Borifthenes, between Mufcovy and Poland.

ANDREW, or, *Knights of St* ANDREW, an order of knights, more ufually called the order of the thiftle. See THISTLE.

Knights of St ANDREW is alfo an order inftituted by Peter the Great of Mufcovy in 1698; the badge of which is a golden medal, on one fide whereof is reprefented St Andrew's crofs, with thefe words, *Cazar Pierre monarque de tout la Ruffie*. This medal, being faftened to a blue ribbon, is fufpended from the right fhoulder.

St ANDREW'*s crofs*, one in form of the letter X. See CROSS.

St ANDREW'S-*day*, a feftival of the Chriftian church, celebrated on the thirteenth of November, in honour of the apoftle St Andrew.

St ANDREWS, in geography, a town in the county of Fife in Scotland, fituated on the German Ocean, in W. long. 2° 25′, and N. lat. 56° 20′, about 30 miles N. E. of Edinburgh.

St Andrews was formerly an archbifhop's fee, but at prefent is chiefly remarkable on account of its univerfity.

St ANDREWS is alfo the name of a town of Carinthia in Germany, fituated in E. long. 15°, and N. lat. 47°, about a hundred miles fouth of Vienna.

ANDRIA, in Grecian antiquity, public entertainments firft inftituted by Minos of Crete, and, after his example, appointed by Lycurgus at Sparta, at which a whole city or a tribe affifted. They were managed with the utmoft frugality, and perfons of all ages were admitted, the younger fort being obliged by the lawgiver to repair thither, as to fchools of temperance and fobriety.

ANDRIA, among fome naturalifts, denotes an hermaphroditical woman. See HERMAPHRODITE.

ANDRIA, in geography, a town of Italy, in the kingdom of Naples, fituated in E. long. 17°, and N. lat. 41° 6′. It is a bifhop's fee.

ANDROAS, or ANDRODAMAS, among ancient naturalifts, a kind of pyritæ, to which they attributed certain magical virtues.

ANDROGYNOUS, in zoology, an appellation given to animals which have both the male and female fex in the fame individual.

ANDROGYNOUS *baths*, in antiquity, thofe common to both fexes. See BATH.

ANDROIDES, in mechanics, a human figure, which, by certain fprings, performs feveral external functions of a man. See AUTOMATON.

ANDROLEPSY, in Grecian antiquity, an action allowed by the Athenians againft fuch as protected perfons guilty of murder. The relations of the deceafed were empowered to feize three men in the city or houfe whither the malefactor had fled, till he were either

either surrendered, or satisfaction made some other way for the murder.

ANDROLEPSY is sometimes also used to signify reprisals. See REPRISAL.

ANDROMACHUS's *treacle*. See THERIACA.

ANDROMEDA, in astronomy, a northern constellation, consisting of 27 stars, visible to the naked eye, behind Pegasus, Cassiopeia, and Perseus. See ASTRONOMY.

ANDROMEDA, in botany, a genus of the decandria monogynia class. The calix is divided into five parts; the corolla is ovated and quinquifid; and the capsule has five cells or divisions. There are nine species of the andromeda, *viz.* the tetragona, hypnoides, and cerulea, natives of Lapland and the Alps; the mariana, paniculata, arborea, and calyculata, natives of Virginia; the polifolia, marsh-cistus, or wild rosemary, a native of G. Britain; and the racemosa, a native of Pensylvania.

ANDRON, in Grecian antiquity, denotes the apartment in houses designed for the use of men; in which sense, it stands opposed to gynæceum. See GYNÆCEUM.

ANDRONION, among ancient physicians, a name given to certain troches invented by Andron.

ANDROPHAGI. See ANDROPOPHAGI.

ANDROPOGON, in botany, a genus of the polygamia monœcia class. This genus contains 18 species, *viz.* the caricosum, contortum, divaricatum, nutans, gryllus, insulare, ravennæ, alopecuroides, distachyon, schoenanthus, virginicum, bicorne, hirtum, nardus, muticum, ischoemum, fasciculatum, and polydactylon, most of them natives of the Indies.

ANDROS, an island in the Archipelago, near the south end of Negropont.

ANDROSACE, in botany, a genus of the pentandria monogynia class. The umbella of the androsace is inclosed in an involucrum; the corolla is ovated; and the capsule is globular, and consists of one apartment. There are six species of this genus; *viz.* the maxima, a native of Austria; the septentrionalis, a native of Lapland, Russia, and the Alps; the villosa, a native of the Pyrenean mountains; the lactea, a native of Austria; the carnea, a native of Switzerland; and the elongata, a native of Austria.

ANDROSÆMUM, in botany, a synonyme of several species of hypericum. See HYPERICUM.

ANDROMOTY, or ANDRANOTOMY, the dissection of human bodies. See ANATOMY.

ANDRUM, a kind of hydrocele, to which the people of Malabar are very subject. See HYDROCELE, and MEDICINE.

ANDRYALA, in botany, a genus of the syngenesia polygamia æqualis class. The receptacle is villous; the calix is divided into many equal round pieces; and the pappus is simple and sessile. There are four species of the andryala, *viz.* the intregifolia, a native of France and Sicily; the ragusina, a native of the Archipelagus; the sinuata, a native of Montpelier and Sicily; and the lanata, a native of the southern parts of Europe.

ANDUXAR, a city of Andalusia in Spain, situated on the river Guadalquiver, about 32 miles east of Corduba, in W. long. 4°. and N. lat. 37° 50′.

ANDUZE. See ANDEUSE.

ANEE, in commerce, a measure for grain, used in some provinces of France. At Lyons, it signifies also a certain quantity of wine, which is the load an ass can carry at once: Which is fixed at 80 English quarts, wine measure.

ANEGADA, one of the Caribbee islands, situated in W. long. 63° 5. and N. lat. 18°.

ANELE, or ANIL, in our old statutes, names used for indigo. See INDIGO.

ANEMABO. See ANNAMABOE.

ANEMIUS, among chemists, an appellation given to a wind-furnace, used in making fire-furnaces for melting and distillation.

ANEMOMACHIA, a term used by ancient naturalists for a whirlwind or hurricane.

ANEMOMETER, among mechanical philosophers, an instrument contrived for measuring the strength of the wind.

ANEMONE, in botany, a genus of the polyandria polygynia class. It has no calix; the petals are from six to nine, and the seeds are numerous. There are 21 species of anemone, most of them natives of Europe, and only the nemorosa and pulsatilla are natives of Britain.

ANEMOSCOPE, a machine shewing from what point of the compass the wind blows. It denotes also an instrument invented to foretell the changes of the wind.

ANET, a town in the isle of France, upon the river Eure.

ANETHUM, in botany, a genus of the pentandria digynia class. The fruit is oval, compressed, and striated. There are only two species of anethum; *viz.* the graveolens, a native of Spain; and the feniculum, fennel, or finckle, a native of Britain. The seeds of the graveolens are recommended as a carminative. The best preparations of them are, the distilled oil, and a tincture or extract made with rectified spirit.

ANEURISM, or ANEURYSM, in surgery, a throbbing tumor, distended with blood, and formed by a dilatation or rupture of an artery. See SURGERY.

ANFA, a city of Africa, in the kingdom of Fez, situated on the sea-coast, between Rabat and Azamar.

ANGAMALA, a small city of India, situated upon the river Aicotta, on the Malabar coast.

ANGARIA, in Roman antiquity, a kind of public service imposed on the provincials, which consisted in providing horses and carriages for the conveyance of military stores, and other public burdens. It is sometimes also used for a guard of soldiers, posted for the defence of a place. In a more general sense, it is used for any kind of oppression, or services performed through compulsion.

ANGASMAGO, a river of S. America. During the reign of the Incas, it bounded the kingdom of Peru on the north, as the river Maule did on the south. See PERU.

ANGEIOGRAPHY, or ANGEIOLOGY, among anatomists,

mists the description and history of the several vessels of the human body.

ANGEIOGRAPHY, among antiquarians, denotes the description of the various utensils, weights, measures, *&c.* of the ancients.

ANGEIOTOMY, in surgery, a term sometimes used for the opening of a vein or artery.

ANGEL, a name given to those spiritual intelligent beings, who are supposed to execute the will of God, in the government of the world.

The existence of angels has been admitted in all religions. The Greeks and Latins acknowledged them under the name of *genii* or *dæmons*; and, in the alcoran, we find frequent mention of them, the Mahometans assigning them different orders and degrees, and different employments, both in heaven and earth.

ANGEL is likewise a title given to bishops of several churches. In this sense is St Paul understood by some authors, where he says, ***Women ought to be covered in the church, because of the angels***; and thus, in the Revelation, *The seven stars are the angels*, that is, bishops, *of the seven churches*.

ANGEL, in commerce, the name of an ancient gold coin in England, of which some are still to be seen in the cabinets of the curious. It had its name from the figure of an angel represented upon it. It was $23\frac{1}{2}$ carats, and weighed four penny-weights. Its value differed in different reigns.

ANGEL-FISH, in ichthyology. See SQUALUS.

ANGELIC, or ANGELICAL, an epithet given to whatever belongs to, or partakes of the nature of angels. See ANGEL.

ANGELIC *Art*. See ART.

ANGELIC *Habit*. See HABIT.

ANGELICA, in botany, a genus of the pentandria digynia class. The fruit of the angelica is roundish, with three furrows on each side; the corolla is equal, and the petals turned inward at the top. There are four species of angelica, *viz.* the archangelica, a native of Lapland; the sylvestris, a native of Britain; the purpurea, and the lucida, both natives of Canada. All the parts of the archangelica, but particularly the roots, are aromatic, and used in several alexeterial waters.

ANGELICA, in Grecian antiquity, a celebrated dance, performed at their feasts, so called, because the dancers were dressed in the habit of messengers.

ANGELICS, in church-history, an ancient sect of heretics, supposed by some to have got this appellation from their excessive veneration of angels; and by others, from their maintaining that the world was created by angels.

ANGELICS is also the name of an order of knights, instituted in 1191, by Angelus Flavius Comnenus emperor of Constantinople.

ANGELICS is also a congregation of nuns, founded at Milan in 1534, by Louisa Torelli, countess of Guastalla. They observe the rule of St Augustine.

ANGELITES, in church-history, an ancient sect of heretics, whose distinguishing tenent was, That the Trinity have no distinct substance, but partake in common of the same divine essence.

ANGELO, or ST ANGELO, a sea-port town of Apuglia in Naples, situated on the gulf of Venice, in 16° 25′ E. long. and 41° 20′ N. lat. It is also the name of two other small towns in Italy, one situated in the kingdom of Naples, and the other in the province of Urbino.

ANGELOLATRIA, among ecclesiastical writers, the adoration or worship of angels.

ANGELOS, a fine city of Mexico, situated in 103° W. long. and 19° N. lat. about 75 miles south-east of the city of Mexico.

ANGELOT, a gold coin struck at Paris, while subject to the English; so called from the representation of an angel supporting the arms of England and France.

ANGELUS. See ANGEL

ANGER, a violent desire to be avenged for some supposed injury. See MORALS.

ANGERBURG, a city of Prussia, in the province of Bartenland, upon the river Angerap.

ANGERMANNIA, a maritime province of Sweden, lying on the western shore of the Bothnic gulph.

ANGERMUND, a town of the dutchy of Berg in Germany, situated on the east side of the Rhine, in 6° 20′ E. long. and 51° 10′ N. lat. It lies about nine miles north of Dusseldorp, and is subject to the elector Palatine.

ANGERONALIA, in antiquity, feasts celebrated at Rome in honour of Angerona, the goddess of silence and patience. They were instituted, according to Macrobius, in consequence of a vow, when the people were afflicted with the quinzy. They were held on the 21st of December.

ANGERS, a large city of France, capital of the province of Anjou, and situated on the river Loire, in 30′ W. long. and 47° 30′ N. lat. It is a bishop's see, and has a royal academy for the study of the law chiefly.

ANGHIERA, a town of the Milanese in Italy, situated on the east side of the Laco Maggiore, about 40 miles west of Milan, in 9° E. long. and 45° 40′ N. lat.

ANGINA, in medicine, a violent inflamation of the throat, otherwise called *quinzy*. See MEDICINE.

ANGIOSPERMIA, in the Linnæan system of botany, denotes those plants of the didynamia class, which have their seeds inclosed in capsules, or seed-vessels. See DIDYNAMIA, and BOTANY.

ANGLE, in geometry, the inclination of two lines meeting one another in a point, and called the *legs of the angle*. See GEOMETRY.

Spherical ANGLE, that formed by the intersection of two great circles of the sphere. See TRIGONOMETRY.

ANGLES *of the eye*, in anatomy, the same with the corners of the eye, called by anatomists *canthi*.

ANGLER, a person who practises the art of angling.

ANGLESEY, an island on the coast of N. Wales, which sends one member to parliament.

ANGLICANUS *Sudor*, among physicians. See SUDOR.

ANGLICISM, in style, a manner of speech peculiar to the English language.

ANGLING, among sportsmen, the art of fishing with

a rod, to which are fitted a line, hook, and bait.— For the ſeveral methods of angling for ſalmon, trout, carp, tench, pearch, flounder, *&c.* See *Salmon*-FISHING, *Trout*-FISHING, *&c.*

ANGLO-CALVINISTS, a name given by ſome writers to the members of the church of England, as agreeing with the other Calviniſts in moſt points, except church-government.

ANGLO-SAXON, an apellation given to the language ſpoken by the Engliſh Saxons, in contradiſtinction from the true Saxon, as well as from the modern Engliſh.

ANGOL, a city of Chili in S. America, ſituated in 78° W. long. and 38° S. lat.

ANGOLA, a large maritime country on the ſouth-weſt ſide of Africa, lying between 10° and 15° E. long. and 5° and 16° S. lat.

The Portugueſe have ſeveral colonies and conſiderable ſettlements on this coaſt, which does not hinder the other nations of Europe from driving a traffic in ſlaves with the natives, who are all negroes.

ANGOLA-*ſeeds*. See MOLUCCA.

ANGON, in the ancient military art, a kind of javelin uſed by the French. They darted it at a conſiderable diſtance. The iron head of this weapon reſembled a flower-de-luce. It is the opinion of ſome writers, that the arms of France are not flowers-de-luce, but the iron point of the angon, or javelin of the ancient French.

ANGONÆUS, in anatomy, a name ſometimes given to the muſcle called *anconæus*. See page 197.

ANGOR, among ancient phyſicians, a concentration of the natural heat, the conſequence of which is a pain of the head, palpitation, and ſadneſs.

ANGOULESME, a city of France, ſituated about 64 miles ſouth-eaſt of Rochelle, in 10′ E. long. and 45° 40′ N. lat. It is the capital of Angoumois. See the next article.

ANGOUMOIS, a province of France, bounded by Poictou on the north, by Limoſin on the eaſt, by Perigord on the ſouth, and by Santoin on the weſt.

ANGOURA, formerly Ancyra, a large populous city of Natolia, in Aſiatic Turkey, ſituated on the river Melus; E. long. 33°. N. lat. 41° 5′.

ANGRA, the principal town of the iſland of Tercera, one of the Azores. See AZORES.

ANGROGNA, a town of Piedmont, ſituated about ſeven miles weſt of Pignerol; E. long. 7°. N. lat. 44° 45′.

ANGUIAN, or ENGUIEN, a ſmall town of the Netherlands, between Bruſſels and Mons.

ANGUILLA, in zoology, a ſynonime of the nereis acuſtris, an inſect belonging to the order of vermes molluſca. See NEREIS. It is alſo the trivial name of a ſpecies of muræna or eel. See MURÆNA.

ANGUILLA, in geography, one of the Caribbee iſlands, ſubject to G. Britain, and ſituated in W. long. 63°. and N. lat. 18° 15′.

ANGUILLARA, a town in the territory of Padua, belonging to the ſtate of Venice.

ANGUILLARA, is alſo a town of St Peter's patrimony, about 18 miles from Rome.

ANGUILLIFORM, an appellation given by zoologiſts, not only to the different ſpecies of eels, but to other animals reſembling them in ſhape.

ANGUINA, in botany, a ſynonime of the trichoſanthes. See TRICHOSANTHES.

ANGUINEAL, denotes ſomething belonging to, or reſembling a ſnake, anguis.

ANGUINUM *ovum*, among ancient naturaliſts, a fabulous kind of egg, ſaid to be produced by the ſaliva of a cluſter of ſerpents, and poſſeſſed of certain magical virtues.

ANGUIS, or SNAKE, in zoology, a genus belonging to the order of amphibia ſerpentes. The characters of the anguis are theſe: They are ſquamous or ſcally in the belly and under the tail. There are 16 ſpecies of the anguis; *viz.* 1. The quadrupes: The body of this ſpecies is cylindrical, with 14 or 15 longitudinal aſh-coloured ſtreaks; the teeth are extremely ſmall; it has no ears; the feet are at a great diſtance from each other, very ſhort, with five toes and ſmall nails; but the toes are ſo minute that they can hardly be numbered: It is a native of Java. 3. The bipes, is a native of the Indies; it has 100 ſcuta on the belly, and 60 on the tail; the ſcuta are ſuccedanea for feet, ranged on both ſides; it has two ſhort feet, with two toes, near the anus. In every ſcale of the bipes there is a brown point. 3. The meleagris, is likewiſe a native of the Indies, and has 165 ſcuta on the belly, and 32 on the tail: It has ſmall teeth, but no ears. This ſpecies has a great reſemblance to the former. See Plate XXII. fig. 1. 4. The colubrina, is an inhabitant of Egypt, has 180 ſcuta on the belly, and 18 on the tail; it is beautifully variegated with pale and yellowiſh colours. 5. The jaculus, a native of Egypt, has 186 ſcuta on the belly, and 23 on the tail; the ſcales on the belly are broad. 6. The maculata, a native of America, has 200 ſcuta on the belly, and 12 on the tail; it is yellow, and interſperſed with aſh-coloured lines on the back: The head is ſmall in proportion to the body. See Plate XXII. fig. 2. 7. The reticulata, a native of America, has 177 ſcuta on the belly, and 37 on the tail; the colour of the ſcales is browniſh, with a white margin. 8. The ceraſtes, with 200 ſcuta on the belly, and 15 on the tail, is a native of Egypt. 9. The lumbricalis, a native of America, has 230 ſcuta on the belly, and 7 on the tail; its colour is a yellowiſh white. 10. The ventralis, a native of Carolina, has 127 ſcuta on the belly, and 222 on the tail. 11. The platura; the head is oblong and without teeth; the body is about a foot and a half long, black above and white below; the tail is about one ninth of the length of the animal, much compreſſed or flatted, and variegated with black and white; the ſcales are roundiſh, ſmall, not imbricated, but they cannot be numbered. 12. The laticauda, a native of Surinam, has 200 ſcuta on the belly, and 50 on the tail; the tail is compreſſed, acute, pale, with browniſh belts. 13. The ſcytale, a native of the Indies, with 240 ſcuta on the belly, and 13 on the tail. The head is ſmall and oval, and the eyes are little; the body is cylindrical, about a foot and a half long, covered with oval ob-

tuse scales: The tail is thick and obtuse like the head; its colour is white, interspersed with brownish rings; the margins of the scales are of an iron-colour; and the top of the head is blue. See Plate XXII. fig. 3. 14. The eryx, a native of Britain and likewise of America, has 126 scuta on the belly, and 136 on the tail. It is of an ash-colour above, with three black lines interspersed, and blueish below: It is about a span in length, and about the thickness of a man's finger. 15. The fragilis, a native of Europe, has 135 scuta on the belly, and 135 on the tail. 16. The ventralis, a native of Carolina, has 127 scuta on the belly, and 223 on the tail. It is of a greenish ash-colour, and its tail is about thrice as long as its body. According to Linnæus, none of this genus are poisonous.

ANGULAR, in a general sense, denotes something relating to, or that hath angles. See ANGLES.

ANGULARIS *scapulæ*, the name by which some anatomists call the levator scapulæ. See ANATOMY, page 194.

ANGURIA, in botany, a genus of the monœcia diandria class. There are only three species of the anguria, *viz.* the trilobata, pedata, and trifoliata, all natives of America.

ANGUS, a shire or county of Scotland, bounded on the north by the shire of Merns, on the east by the German ocean, on the south by the frith of Tay, which divides it from the shire of Fife, and on the west by the shire of Perth.

This county, which for the most part is exceeding fertile, is otherwise called Forfarshire, from its capital Forfar.

ANGUSTICLAVIA, in Roman antiquity, a tunica embroidered with little purple studs. It was worn by the Roman knights, as the laticlavia was by the senators.

ANHALT, a province of the circle of Upper Saxony, in Germany, lying southward of the duchy of Magdeburg.

ANHELATIO, or ANHELITUS, among physicians, a shortness of breath.

ANHINGA, in ornithology, the trivial name of a species of plotus. See PLOTUS.

ANHYDROS, in botany, an obsolete name of the solanum. See SOLANUM.

ANI, in ornithology, the trivial name of a species of crotophaga. See CROTOPHAGA.

ANIAN, a large maritime country on the eastern coast of Africa, lying between the equator, and 12° N. lat. and between 40° and 50° E. long.

ANIAN is also the name of a strait, supposed to lie between the north-east of Asia and north-west of America.

ANJENGO, a small town and factory on the Malabar coast, belonging to our East-India company.

ANIENS, or ANIENTE, a law-term, signifying to be void, or of no force.

ANIL, in botany, a synonyme of a species of indigofera. See INDIGOFERA.

AMIMA, among divines and naturalists, denotes the soul, or principle of life, in animals.

ANIMA, among chemists, denotes the volatile or spiritous parts of bodies.

ANIMA *hepatis*, is a name by which some call sal martis, or salt of iron, on account of its supposed efficacy in diseases of the liver.

ANIMA *saturni*, a white powder obtained by pouring distilled vinegar on litharge, of considerable use in enamelling. See ENAMEL.

ANIMA, or ANIMATO, in music, the same with allegro. See ALLEGRO.

ANIMACHA, a river of India, in the kingdom of Malabar. It rises in the kingdom of Calicut, and falls into the ocean six leagues from Cranganor. It is also the name of a town upon the river.

ANIMADVERSION, in matters of literature, is used to signify, sometimes correction, sometimes remarks upon a book, *&c.* and sometimes a serious consideration upon any point.

ANIMAL, in natural history, an organized body endowed with sensation: Thus, minerals are said to grow or increase; plants to grow and live; but animals alone to have sensation. See NATURAL HISTORY.

ANIMALS, in heraldry, are much used, both as bearings and supporters. See HERALDRY.

ANIMAL, used adjectively, denotes any thing belonging to, or partaking of the nature of animals. Thus, animal actions, those that are peculiar to animals; such are sensation and muscular motion.

ANIMAL *spirits*. See NERVOUS *fluid*.

ANIMAL *system* denotes the whole class of beings endowed with animal life, otherwise called *animal kingdom*.

ANIMALCULE, an animal so minute in its size, as not to be the immediate object of our senses. See MICROSCOPE.

ANIMATED, or ANIMATE, in a general sense, denotes something endowed with animal life. It also imports a thing to be impregnated with vermin or animalcules.

ANIME, in heraldry, a term used when the eyes of any rapacious creature are born of a different tincture from the creature itself.

ANIMETTA, among ecclesiastical writers, denotes the cloth wherewith the cup of the eucharist is covered.

ANIMI *diliquium*, fainting or swooning.

ANINGA, in commerce, a root which grows in the Antilles islands, and is pretty much like the China plant. It is used by sugar-bakers, for refining the sugar; and is more effectual, and less dangerous, than the sublimate of mercury and arsenic.

ANJOU, a country, or rather earldom of France, bounded by the province of Maine on the north, by Tourain on the east, by Poictou on the south, and by Britany on the west.

ANISCALPTOR, in anatomy, a name by which some call the latissimus dorsi. See page 195.

ANITERSOR, in anatomy, another name by which some call the latissimus dorsi.

ANKER,

ANKER, a liquid meaſure at Amſterdam. It contains about 32 gallons Engliſh meaſure.

ANN, or ANNAT, in Scots law, is half a year's ſtipend, which the law gives to the executors of miniſters of the church of Scotland, over and above what was due to the miniſter himſelf, for his incumbency. See SCOTS LAW, title, *Eccleſiaſtical perſons.*

ANNA, in Roman antiquity, an appellation given to the moon. See the article MOON.

ANNA, in geography, a city of Arabia Petrea, ſituated on the weſtern ſhore of the river Euphrates, in 41° 35′ of E. long, and 33° 30′ N. lat.

ANNAACIOUS, a people of Braſil, in America, whoſe country borders on the government of Porto Seguro.

ANNABERG, a ſmall town of Germany, in the province of Miſnia, ſituated near the river Schop, about 11 German miles from Leipſic.

ANNAGH, the name of two towns in Ireland, one in the province of Ulſter, and the other in the county of Downe.

ANNALE, in the church of Rome, a term applied to the maſſes celebrated for the dead during a whole year.

ANNALS, in matters of literature, a ſpecies of hiſtory, which relates events in the chronological order wherein they happened. They differ from perfect hiſtory in this, that annals are a bare relation of what happened every year, as a journal is of what paſſes every day; whereas hiſtory relates, not only the tranſactions themſelves, but alſo the cauſes, motives, and ſprings of actions.

ANNALES, in law. See YEARLINGS.

ANNAMABOE, an Engliſh factory on the gold coaſt, in Guinea, in Africa.

ANNAN, the capital of the ſhire of Annandale, in Scotland, ſituated upon a river of the ſame name, in 3° W. long. and 54° 40′ N. lat.

ANNAPOLIS, the capital of Maryland, a Britiſh colony in N. America, in 78° W. long. and 39° 25′ N. lat.

ANNAPOLIS, is alſo the name of the capital of Nova Scotia, ſituated in 64° W. long. and 45° N. lat.

ANNATES, among eccleſiaſtical writers, a year's income of a ſpiritual living.

These were, in ancient times, given to the pope through all Chriſtendom, upon the deceaſe of any biſhop, abbot, or pariſh-clerk, and were paid by his ſucceſſor. At the reformation they were taken from the pope, and veſted in the king; and finally, queen Ann reſtored them to the church, by appropriating them to the augmentation of poor livings.

ANNEALING, or NEALING, the burning or baking glaſs, earthen ware, *&c.* in an oven or furnace. See NEALING.

ANNE, or ST ANNE'*s-day*, a feſtival of the Chriſtian church, celebrated by the Latins on the twenty-ſixth of July, but by the Greeks on the ninth of December. It is kept in honour of Anne, or Anna, mother of the Virgin Mary.

ANNECY, a town of the duchy of Savoy, ſituated upon a lake of the ſame name, ſubject to the king of Sardinia, in 6° 10′ E. long. and 46° N. lat.

ANNEXATION, in law, a term uſed to imply the uniting of lands or rents to the crown.

ANNI *nubiles*, in law, denotes the marriageable age of a woman, *viz.* after ſhe has arrived at twelve.

ANNIENTED, in law, ſignifies annulled or made void.

ANNIHILATION, the act of reducing any created being into nothing.

ANNIVERSARY, the annual return of any remarkable day. Anniverſary days, in old times more particularly, denoted thoſe days in which an office was performed for the ſouls of the deceaſed, or the martyrdom of the ſaints was celebrated in the church.

ANNOBON, an iſland of Africa, on the coaſt of Guinea, in 7° E. long. and 1° 50′ S. lat.

ANNO *Domini*, i. e. the year of our Lord, the computation of time from our Saviour's incarnation.

ANNOISANCE, in law, the ſame with nuſance. See NUSANCE.

ANNOMINATION, in rhetoric, the ſame with what is otherwiſe called *paronomaſia*. See PARONOMASIA.

ANNONA, in Roman antiquity, denotes proviſion for a year of all ſorts, as of fleſh, wine, *&c.* but eſpecially of corn. Annona is likewiſe the allowance of oil, ſalt, bread, fleſh, corn, wine, hay, and ſtraw, which was annually provided by the contractors for the maintenance of an army.

ANNONÆ *præfectus*, in antiquity, an extraordinary magiſtrate, whoſe buſineſs it was to prevent a ſcarcity of proviſion, and to regulate the weight and fineneſs of bread.

ANNONAY, a town of France in the upper Vivares, ſituated on the river Deume, in 5° 22′ E. long. and 45° 15′ N. lat.

ANNOT, a ſmall city in the mountains of Provence in France, in 7° E. long. and 44° 4′ N. lat.

ANNOTATION, in matters of literature, a brief commentary, or remark upon a book or writing, in order to clear up ſome paſſage, or draw ſome concluſion from it.

ANNUA *penſione*, in law, an old writ for granting an annual penſion to one of the king's chaplains.

ANNUAL, in a general ſenſe, an appellation given to whatever returns every year, or is always performed within that ſpace of time: Thus we ſay, The annual motion of the earth, annual plants, *&c.*

ANNUALRENT, in Scots law, an yearly profit due by a debtor in a ſum of money to a creditor for the uſe of it. See SCOTS LAW, title, *Obligations ariſing from conſent.*

Right of ANNUALRENT, in Scots law, the original method of burdening lands with an yearly payment for the loan of money, before the taking of intereſt for money was allowed by ſtatute. See SCOTS LAW, title, *Heretable and moveable rights.*

ANNUENTES *muſculi*, in anatomy, the ſame with recti interni minores. See ANATOMY, Part II.

A N N U I T I E S.

AN Annuity is a ſum of money, payable yearly, half-yearly, or quarterly, to continue a certain number of years, for ever, or for life.

An annuity is ſaid to be in arrear, when it continues unpaid after it falls due. And an annuity is ſaid to be in reverſion, when the purchaſer, upon paying the price, does not immediately enter upon poſſeſſion; the annuity not commencing till ſome time after.

Intereſt on annuities may be computed either in the way of ſimple or compound intereſt. But compound intereſt, being found moſt equitable, both for buyer and ſeller, the computation by ſimple intereſt is univerſally diſuſed.

I. *Annuities for a certain Time.*

Problem 1. Annuity, rate, and time, given, to find the amount, or ſum of yearly payments, and intereſt.

Rule. Make 1 the firſt term of a geometrical ſeries, and the amount of 1 l. for a year the common ratio; continue this ſeries to as many terms as there are years in the queſtion; and the ſum of this ſeries is the amount of 1 l. annuity for the given years; which, multiplied by the given annuity, will produce the amount ſought.

Example. An annuity of 40 l. payable yearly, is forborn and unpaid till the end of 5 years: What will then be due, reckoning compound intereſt at 5 *per cent.* on all the payments then in arrear?

1   2   3   4   5
1 : 1.05 : 1.1025 : 1.157625 : 1.21550625; whoſe ſum is 5.52563125 l.; and 5.52563125 × 40 = 221.02525 = 221 l. 0 s. 6 d. the amount ſought.

The amount may alſo be found thus: Multiply the given annuity by the amount of 1 l. for a year; to the product add the given annuity, and the ſum is the amount in 2 years; which multiply by the amount of 1 l. for a year; to the product add the given annuity, and the ſum is the amount in 3 years, &c. The former queſtion wrought in this manner follows.

40 am. in 1 year.	126.1 am. in 3 years.
1.05	1.05
42.00	132.405
40	40
82 am. in 2 years.	172.405 am. in 4 years.
1.05	1.05
86.10	181.02525
40	40
126.1 am. in 3 years.	221.02525 am. in 5 years.

If the given time be years and quarters, find the amount for the whole years, as above; then find the amount of 1 l. for the given quarters; by which multiply the amount for the whole years; and to the product add ſuch a part of the annuity as the given quarters are of a year.

If the given annuity be payable half-yearly, or quarterly, find the amount of 1 l. for half a year or a quarter; by which find the amount for the ſeveral half-years or quarters, in the ſame manner as the amount for the ſeveral years is found above.

Prob. 2. Annuity, rate, and time given, to find the preſent worth, or ſum of money that will purchaſe the annuity.

Rule. Find the amount of the given annuity by the former problem; and then, by compound intereſt, find the preſent worth of this amount, as a ſum due at the end of the given time.

Examp. What is the preſent worth of an annuity of 40 l. to continue 5 years, diſcounting at 5 *per cent.* compound intereſt?

By the former problem, the amount of the given annuity for 5 years, at 5 *per cent.* is 221.02525; and by compound intereſt, the amount of 1 l. for five years, at 5 l. *per cent.* is 1.2762815625

And, 1.2762815625)221.02525000(173.179 = 173 l. 3 s. 7 d. the preſent worth ſought.

The preſent worth may alſo be found thus: By compound intereſt, find the preſent worth of each year by itſelf, and the ſum of theſe is the preſent worth ſought. The former example done in this way follows.

1.2762815625)40.000000000	(31.3410
1.21550625)40.0000000	(32.9080
1.157625)40.00000	(34.5535
1.1025)40.000	(36.2811
1.05)40.0	(38.0952
Preſent worth,	173.1788

If the annuity to be purchaſed be in reverſion, find firſt the preſent worth of the annuity, as commencing immediately, by any of the methods taught above; and then, by compound intereſt, find the preſent worth of that preſent worth, rebating for the time in reverſion; and this laſt preſent worth is the anſwer.

Examp. What is the preſent worth of a yearly penſion or rent of 75 l. to continue 4 years, but not to commence till 3 years hence, diſcounting at 5 *per cent.*?

.05 : 1 :: 75 : 1500
1.05 × 1.05 × 1.05 × 1.05 = 1.21550625
1.21550625)1500.00000(1234.05371
1500
1234.05371

265.94629, preſent worth of the annuity, if it was to commence immediately.

1.05 × 1.05 × 1.05 = 1.157625.   *L.*   *s.*   *d.*
1.157625)265.94629(229.7344 = 229   14   8¼

Prob. 3. Preſent worth, rate and time given, to find the annuity.

Rule.

Rule. By the preceding problem, find the preſent worth of 1 l. annuity for the rate and time given; and then ſay, As the preſent worth thus found to 1 l. annuity, ſo the preſent worth given to its annuity; that is, divide the given preſent worth by that of 1 l. annuity.

Examp. What annuity, to continue 5 years, will 173 l. 3 s. 7. purchaſe, allowing compound intereſt at 5 *per cent*.

.05 : 1 :: 1 : 20 l.
1.05 × 1.05 × 1.05 × 1.05 × 1.05 = 1.2762815625
1.2762815625)20.000000000(15.6705.
20
15.6705

4.3295 preſent worth of 1 l. annuity.
4.329)173.179(40 l. annuity. *Anſ.*

II. *Annuities for ever, or freehold Eſtates.*

In freehold eſtates, commonly called *annuities in fee-ſimple*, the things chiefly to be conſidered are, 1. The annuity or yearly rent. 2. The price or preſent worth. 3. The rate of intereſt. The queſtions that uſually occur on this head will fall under one or other of the following problems.

Prob. 1. Annuity and rate of intereſt given, to find the price.

As the rate of 1 l. to 1 l. ſo the rent to the price.

Examp. The yearly rent of a ſmall eſtate is 40 l.: What is it worth in ready money, computing intereſt at $3\frac{1}{2}$ *per cent*.

		L.	s.	d.
As .035 : 1 :: 40 : 1142.857142 =		1142	17	$1\frac{1}{7}$

Prob. 2. Price and rate of intereſt given, to find the rent or annuity.

As 1 l. to its rate, ſo the price to the rent.

Examp. A gentleman purchaſes an eſtate for 4000 l. and has $4\frac{1}{2}$ *per cent*. for his money: Required the rent.

As 1 : .045 :: 4000 : 180 l. rent ſought.

Prob. 3. Price and rent given, to find the rate of intereſt.

As the price to the rent, ſo 1 to the rate.

Examp. An eſtate of 180 l. yearly rent is bought for 4000 l.: What rate of intereſt has the purchaſer for his money?

As 4000 : 180 :: 1 : .045 rate ſought.

Prob. 4. The rate of intereſt given, to find how many years purchaſe an eſtate is worth.

Divide 1 by the rate, and the quot is the number of years purchaſe the eſtate is worth.

Examp. A gentleman is willing to purchaſe an eſtate, provided he can have $2\frac{1}{2}$ *per cent*. for his money: How many years purchaſe may he offer?

.025)1.000(40 years purchaſe. *Anſ.*

Prob. 5. The number of years purchaſe at which an eſtate is bought or ſold, given, to find the rate of intereſt.

Divide 1 by the number of years purchaſe, and the quot is the rate of intereſt.

Examp. A gentleman gives 40 years purchaſe for an eſtate: What intereſt has he for his money?

40)1.000(.025 rate ſought.

The computations hitherto are all performed by a ſingle diviſion or multiplication, and it will ſcarcely be perceived that the operations are conducted by the rules of compound intereſt; but when a reverſion occurs, recourſe muſt be had to tables of annuities on compound intereſt.

Prob. 6. The rate of intereſt, and the rent of a freehold eſtate in reverſion, given, to find the preſent worth or value of the reverſion.

By Prob. 1. find the price or preſent worth of the eſtate, as if poſſeſſion was to commence preſently; and then, by the Tables, find the preſent value of the given annuity, or rent, for the years prior to the commencement; ſubtract this value from the former value, and the remainder is the value of the reverſion.

Examp. A has the poſſeſſion of an eſtate of 130 l. *per annum*, to continue 20 years; B has the reverſion of the ſame eſtate from that time for ever: What is the value of the eſtate, what the value of the 20 years poſſeſſion, and what the value of the reverſion, reckoning compound intereſt at 6 *per cent*.

By Prob. 1. .06)130.00(2166.6666 value of the eſtate.
By Tables 1491.0896 val. of the poſſeſſion.

675.5770 val. of the reverſion.

Prob. 7. The price or value of a reverſion, the time prior to the commencement, and rate of intereſt, given, to find the annuity or rent.

By the Tables, find the amount of the price of the reverſion for the years prior to the commencement; and then, by Prob. 2. find the annuity which that amount will purchaſe.

Examp. The reverſion of a freehold eſtate, to commence 20 years hence, is bought for 675.577 l. compound intereſt being allowed at 6 *per cent*.: Required the annuity or rent.

By the Tables the amount of 675.577 l. for 20 years, at 6 *per cent*. is } L. 2166.6

By Prob. 2. 2166.6 × .06 = 130.0 rent ſought.

III. *Life Annuities.*

The value of annuities for life is determined from obſervations made on the bills of mortality. Dr Halley, Mr Simpſon, and Monſ. de Moivre, are gentlemen of diſtinguiſhed merit in calculations of this kind.

Dr Halley had recourſe to the bills of mortality at Breſlaw, the capital of Sileſia, as a proper ſtandard for the other parts of Europe, being a place pretty central, at a diſtance from the ſea, and not much crowded with traffickers or foreigners. He pitches upon 1000 perſons all born in one year, and obſerves how many of theſe were alive every year, from their birth to the extinction of the laſt, and conſequently how many died each year, as in the firſt of the following tables; which is well adapted to Europe in general. But in the city of London, there is obſerved to be a greater diſparity in the births and burials than in any other place, owing probably to the vaſt reſort of people thither, in the way of commerce, from all parts of the known world. Mr Simpſon, therefore, in order to have a table particularly ſuited

ſuited to this populous city, pitches upon 1280 perſons all born in the ſame year, and records the number remaining alive each year, till none were in life.

Dr Halley's table on the bills of mortality at Breſlaw.

Age.	*Perſ. liv.*	*A.*	*Perſ. liv.*	*A.*	*Perſ. liv.*	*A.*	*Perſ. liv.*
1	1000	24	573	47	377	70	142
2	855	25	567	48	367	71	131
3	798	26	560	49	357	72	120
4	760	27	553	50	346	73	109
5	732	28	546	51	335	74	98
6	710	29	539	52	324	75	88
7	692	30	531	53	313	76	78
8	680	31	523	54	302	77	68
9	670	32	515	55	292	78	58
10	661	33	507	56	282	79	49
11	653	34	499	57	272	80	41
12	646	35	490	58	262	81	34
13	640	36	481	59	252	82	28
14	634	37	472	60	242	83	23
15	628	38	463	61	232	84	20
16	622	39	454	62	222	85	15
17	616	40	445	63	212	86	11
18	610	41	436	64	202	87	8
19	604	42	427	65	192	88	5
20	598	43	417	66	182	89	3
21	592	44	407	67	172	90	1
22	586	45	397	68	162	91	0
23	579	46	387	69	152		

Mr Simpſon's table on the bills of mortality at London.

Age.	*Perſ. liv.*	*A.*	*Perſ. liv.*	*A.*	*Perſ. liv.*	*A.*	*Perſ. liv.*
0	1280	24	434	48	220	72	59
1	870	25	426	49	212	73	54
2	700	26	418	50	204	74	49
3	635	27	410	51	196	75	45
4	600	28	402	52	188	76	41
5	580	29	394	53	180	77	38
6	564	30	385	54	172	78	35
7	551	31	376	55	165	79	32
8	541	32	367	56	158	80	29
9	532	33	358	57	151	81	26
10	524	34	349	58	144	82	23
11	517	35	340	59	137	83	20
12	510	36	331	60	130	84	17
13	504	37	322	61	123	85	14
14	498	38	313	62	117	86	12
15	492	39	304	63	111	87	10
16	486	40	294	64	105	88	8
17	480	41	284	65	99	89	6
18	474	42	274	66	93	90	5
19	468	43	264	67	87	91	4
20	462	44	255	68	81	92	3
21	455	45	246	69	75	93	2
22	448	46	237	70	69	94	1
23	441	47	228	71	64	95	0

It may not be improper in this place to obſerve, that however perfect tables of this ſort may be in themſelves, and however well adapted to any particular climate, yet the concluſions deduced from them muſt always be uncertain, being nothing more than probabilities, or conjectures drawn from the uſual period of human life. And the practice of buying and ſelling annuities on lives, by rules founded on ſuch principles, may be juſtly conſidered as a ſort of lottery or chance-work, in which the parties concerned muſt often be deceived. But as eſtimates and computations of this kind are now become faſhionable, we ſhall here give ſome brief account of ſuch as appear moſt material.

From the above tables the probability of the continuance or extinction of human life is eſtimated as follows.

1. The probability that a perſon of a given age ſhall live a certain number of years, is meaſured by the proportion which the number of perſons living at the propoſed age has to the difference between the ſaid number and the number of perſons living at the given age.

Thus, if it be demanded, what chance a perſon of 40 years has to live ſeven years longer? from 445, the number of perſons living at 40 years of age in Dr Halley's table, ſubtract 377, the number of perſons living at 47 years of age, and the remainder 68, is the number of perſons that died during theſe 7 years; and the probability or chance that the perſon in the queſtion ſhall live theſe 7 years is as 377 to 68, or nearly as $5\frac{1}{2}$ to 1. But, by Mr Simpſon's table, the chance is ſomething leſs than that of 4 to 1.

2. If the year to which a perſon of a given age has an equal chance of arriving before he dies, be required, it may be found thus: Find half the number of perſons living at the given age in the tables, and in the column of age you have the year required.

Thus, if the queſtion be put with reſpect to a perſon of 30 years of age, the number of that age in Dr Halley's table is 531, the half whereof is 265, which is found in the table between 57 and 58 years; ſo that a perſon of 30 years has an equal chance of living between 27 and 28 years longer.

3. By the tables, the premium of inſurance upon lives may in ſome meaſure be regulated.

Thus, The chance that a perſon of 25 years has to live another year, is, by Dr Halley's table, as 80 to 1; but the chance that a perſon of 50 years has to live a year longer is only 30 to 1. And, conſequently, the premium for inſuring the former ought to be to the premium for inſuring the latter for one year, as 30 to 80, or as 3 to 8.

Prob. I. To find the value of an annuity of 1 l. for the life of a ſingle perſon of any given age.

Monſ. de Moivre, by obſerving the decreaſe of the probabilities of life, as exhibited in the table, compoſed an algebraic theorem or canon, for computing the value of an annuity for life; which canon I ſhall here lay down by way of

Rule. Find the complement of life; and, by the tables, find the value of 1 l. annuity for the years denoted by the ſaid complement; multiply this value by the amount

amount of 1 l. for a year, and divide the product by the complement of life; then subtract the quot from 1; divide the remainder by the interest of 1 l. for a year; and this last quot will be the value of the annuity sought, or, in other words, the number of years purchase the annuity is worth.

EXAMP. What is the value of an annuity of 1 l. for an age of 50 years, interest at 5 *per cent.*

86
50 age given.
36 complement of life.

By the Tables, the value is, 16.5468
Amount of 1 l. for a year, 1.05
827340
165468

Complement of life, 36)17.374140(.482615
From unity, *viz.* 1.000000
Subtract .482615
Interest of 1 l. .05).517385(10.3477, value sought.

By the preceding problem is constructed the following table.

The value of 1 l. annuity for a single life.

Age.	3 per c.	3½ per c.	4 per c.	4½ per c.	5 per c.	6 per c.
9=10	19.87	18.27	16.88	15.67	14.60	12.80
8=11	19.74	18.16	16.79	15.59	14.53	12.75
7=12	19.60	18.05	16.64	15.51	14.47	12.70
13	19.47	17.94	16.60	15.43	14.41	12.65
6=14	19.33	17.82	16.50	15.35	14.34	12.60
15	19.19	17.71	16.41	15.27	14.27	12.55
16	19.05	17.59	16.31	15.19	14.20	12.50
5=17	18.90	17.46	16.21	15.10	14.12	12.45
18	18.76	17.33	16.10	15.01	14.05	12.40
19	18.61	17.21	15.99	14.92	13.97	12.35
4=20	18.46	17.09	15.89	14.83	13.89	12.30
21	18.30	16.96	15.78	14.73	13.81	12.20
22	18.15	16.83	15.67	14.64	13.72	12.15
23	17.99	16.69	15.55	14.54	13.64	12.10
3=24	17.83	16.56	15.43	14.44	13.55	12.00
25	17.66	16.42	15.31	14.34	13.46	11.95
26	17.50	16.28	15.19	14.23	13.37	11.90
27	17.33	16.13	15.04	14.12	13.28	11.80
28	17.16	15.98	14.94	14.02	13.18	11.75
29	16.98	15.83	14.81	13.90	13.09	11.65
30	16.80	15.68	14.68	13.79	12.99	11.60
2=31	16.62	15.53	14.54	13.67	12.88	11.50
32	16.44	15.37	14.41	13.55	12.78	11.40
33	16.25	15.21	14.27	13.43	12.67	11.35
34	16.06	15.05	14.12	13.30	12.56	11.25
35	15.86	14.89	13.98	13.17	12.45	11.15
36	15.67	14.71	13.82	13.04	12.33	11.05
37	15.46	14.52	13.67	12.90	12.21	11.00
38	15.29	14.34	13.52	12.77	12.09	10.90
1=39	15.05	14.16	13.36	12.63	11.96	10.80
40	14.84	13.98	13.20	12.48	11.83	10.70

The value of 1 l. annuity for a single life.

A.	3 per c.	3½ per c.	4 per c.	4½ per c.	5 per c.	6 per c.
41	14.63	13.79	13.02	12.33	11.70	10.55
42	14.41	13.59	12.85	12.18	11.57	10.45
43	14.19	13.40	12.68	12.02	11.43	10.35
44	13.96	13.20	12.50	11.87	11.29	10.25
45	13.73	12.99	12.32	11.70	11.14	10.10
46	13.49	12.78	12.13	11.54	10.99	10.00
47	13.25	12.56	11.94	11.37	10.84	9.85
48	13.01	12.36	11.74	11.19	10.68	9.75
49	12.76	12.14	11.54	11.00	10.51	9.60
50	12.51	11.92	11.34	10.82	10.35	9.45
51	12.26	11.69	11.13	10.64	10.17	9.30
52	12.00	11.45	10.92	10.44	9.99	9.20
53	11.73	11.20	10.70	10.24	9.82	9.00
54	11.46	10.95	10.47	10.04	9.63	8.85
55	11.18	10.69	10.24	9.82	9.44	8.70
56	10.90	10.44	10.01	9.61	9.24	8.55
57	10.61	10.18	9.77	9.39	9.04	8.35
58	10.32	9.91	9.52	9.16	8.83	8.20
59	10.03	9.64	9.27	8.93	8.61	8.00
60	9.73	9.36	9.01	8.69	8.39	7.80
61	9.42	9.08	8.75	8.44	8.16	7.60
62	9.11	8.79	8.48	8.19	7.93	7.40
63	8.79	8.49	8.20	7.94	7.68	7.20
64	8.46	8.19	7.92	7.67	7.43	6.95
65	8.13	7.88	7.63	7.39	7.18	6.75
66	7.79	7.56	7.33	7.12	6.91	6.50
67	7.45	7.24	7.02	6.83	6.64	6.25
68	7.10	6.91	6.75	6.54	6.36	6.00
69	6.75	6.57	6.39	6.23	6.07	5.75
70	6.38	6.22	6.06	5.92	5.77	5.50
71	6.01	5.87	5.72	5.59	5.47	5.20
72	5.63	5.51	5.38	5.26	5.15	4.90
73	5.25	5.14	4.02	4.92	4.82	4.60
74	4.85	4.77	4.66	4.57	4.49	4.30
75	4.45	4.38	4.29	4.22	4.14	4.00
76	4.05	3.98	3.91	3.84	3.78	3.65
77	3.63	3.57	3.52	3.47	3.41	3.30
78	3.21	3.16	3.11	3.07	3.03	2.95
79	2.78	2.74	2.70	2.67	2.64	2.55
80	2.34	2.31	2.28	2.26	2.23	2.15

The above table shews the value of an annuity of one pound for a single life, at all the current rates of interest; and is esteemed the best table of this kind extant, and preferable to any other of a different construction. But yet those who sell annuities have generally one and a half or two years more value, than specified in the table, from purchasers whose age is 20 years or upwards.

Annuities of this sort are commonly bought or sold at so many years purchase; and the value assigned in the table may be so reckoned. Thus the value of an annuity of

of one pound for an age of 50 years, at 3 *per cent.* interest, is 12.51; that is, 12 l. 10 s. or twelve and a half years purchase. The marginal figures on the left of the column of age serve to shorten the table, and signify, that the value of an annuity for the age denoted by them, is the same with the value of an annuity for the age denoted by the numbers before which they stand. Thus the value of an annuity for the age of 9 and 10 years is the same; and the value of an annuity for the age of 6 and 14, for the age of 3 and 24, *&c.* is the same. The further use of the table will appear in the questions and problems following.

QUEST. 1. A person of 50 years would purchase an annuity for life of 200 l: What ready money ought he to pay, reckoning interest at $4\frac{1}{2}$ *per cent.?*

	L.
By the table the value of 1 l. is	10.8
Multiply by	200
Value to be paid in ready money	2164.00 *Ans.*

QUEST. 2. A young merchant marries a widow lady of 40 years of age, with a jointure of 300 l. a-year, and wants to dispose of the jointure for ready money: What sum ought he to receive, reckoning interest at $3\frac{1}{2}$ *per cent.?*

	L.
By the table the value of 1 l. is	13.98
	300
Value to be received in ready money	4194.00 *Ans.*

PROB. 2. To find the value of an annuity for the joint continuance of two lives, one life failing, the annuity to cease.

Here there are two cases, according as the ages of the two persons are equal or unequal.

1. If the two persons be of the same age, work by the following

RULE. Take the value of any one of the lives from the table, multiply this value by the interest of 1 l. for a year, subtract the product from 2, divide the foresaid value by the remainder, and the quot will be the value of 1 l. annuity, or the number of years purchase sought.

EXAMP. What is the value of 100 l. annuity for the joint lives of two persons, of the age of 30 years each, reckoning interest at 4 *per cent.?*

By the table, one life of 30 years is	14.68
Multiply by	.04
Subtract the product	5872
From	2.0000
Remains	1.4128

And 1.4128)14.68(10.39 value of 1 l. annuity.

And $10.39 \times 100 = 1039$ the value sought.

2. If the two persons are of different ages, work as directed in the following

RULE. Take the values of the two lives from the table, multiply them into one another, calling the result the first product; then multiply the said first product by the interest of 1 l. for a year, calling the result the second product; add the values of the two lives, and from their sum subtract the second product; divide the first product by the remainder, and the quot will be the value of 1 l. annuity, or the number of years purchase sought.

EXAMP. What is the value of 70 l. annuity for the joint lives of two persons, whereof one is 40 and the other 50 years of age, reckoning interest at 5 *per cent.?*

By the table the value of 40 years is,	11.83
And the value of 50 years is,	10.35
First product,	122.4405
Multiply by	.05
Second product,	6.122025
Sum of the two lives,	22.180000
Second product deduct,	6.122025
Remainder,	16.057975

And 16.057975)122.4405(7.62 value of 1 l. annuity.
70

533.40 value sought.

PROB. 3. To find the value of an annuity upon the longest of two lives; that is, to continue so long as either of the persons is in life.

RULE. From the sum of the values of the single lives, subtract the value of the joint lives, and the remainder will be the value sought.

EXAMP. What is the value of an annuity of 1 l. upon the longest of two lives, the one person being 30, and the other 40 years of age, interest at 4 *per cent.?*

By the table, 30 years is,	14.68
40 years is,	13.20
	27.88
Value of their joint lives, by Prob. 2. Case 2. is,	9.62
Value sought,	18.26

If the annuity be any other than 1 l. multiply the answer found as above by the given annuity.

If the two persons be of equal age, find the value of their joint lives by Case 1. of Prob. 2.

PROB. 4. To find the value of the next presentation to a living.

RULE. From the value of the successor's life, subtract the joint value of his and the incumbent's life, and the remainder will be the value of 1 l. annuity; which multiplied by the yearly income, will give the sum to be paid for the next presentation.

EXAMP. A enjoys a living of 100 l. *per annum*, and B would purchase the said living for his life after A's death: The question is, What he ought to pay for it, reckoning interest at 5 *per cent.* A being 60, and B 25 years of age?

	L.
By the table, B's life is,	13.46
Joint value of both lives, by Prob. 2. is,	6.97
The value of 1 l. annuity,	6.49
Multiply by	100
Value of next presentation,	649.00

The

The value of a direct presentation is the same as that of any other annuity for life, and is found for 1 l. by the the table: which being multiplied by the yearly income, gives the value sought.

PROB. 5. To find the value of a reversion for ever, after two successive lives; or to find the value of a living after the death of the present incumbent and his successor.

RULE. By Prob. 3. find the value of the longest of the two lives, and subtract that value from the value of the perpetuity, and the remainder will be the value sought.

EXAMP. A, aged 50, enjoys an estate or living of 100 l. *per annum*; B, aged 30, is intitled to his lifetime of the same estate after A's death; and it is proposed to sell the estate just now with the burden of A and B's lives on it: What is the reversion worth, reckoning interest at 4 *per cent.?*

	L.
By the table, A's life of 50 is,	11.34
B's life of 30 is,	14.68
Sum,	26.02
Value of their joint lives, found by Prob. 2. Case 2. is,	8.60
Value of the longest life,	17.42 sub.
From the value of the perpetuity,	25.00
Remains the value of 1 l. reversion,	7.58
Multiply by	100
Value of the reversion,	758.00

PROB. 6. To find the value of the joint continuance of three lives, one life failing, the annuity to cease.

RULE. Find the single values of the three lives from the table; multiply these single values continually, calling the result the product of the three lives; multiply that product by the interest of 1 l. and that product again by 2, calling the result the double product; then, from the sum of the several products of the lives, taken two and two, subtract the double product; divide the product of the three lives by the remainder, and the quot will be the value of the three joint lives.

EXAMP. A is 18 years of age, B 34, and C 56: What is the value of their joint lives, reckoning interest at 4 *per cent.?*

By the table, the value of A's life is 16.1, of B's 14.12, and of C's 10.01.

$16.1 \times 14.12 \times 10.01 = 2275.6$, product of the 3 lives.

$$\begin{array}{r} .04 \\ \hline 91.024 \\ 2 \\ \hline 182.048 \end{array}$$ double product.

Product of A and B, $16.1 \times 14.12 =$	227.33
A and C, $16.1 \times 10.01 =$	161.16
B and C, $14.12 \times 10.01 =$	141.34
Sum of all, two and two,	529.83
Double product subtract	182.048
Remainder	347.782

And 347.782)2275.600(6.54 value sought.

PROB. 7. To find the value of an annuity upon the longest of three lives.

RULE. From the sum of the values of the three single lives taken from the table, subtract the sum of all the joint lives, taken two and two, as found by Prob. 2. and to the remainder add the value of the three joint lives, as found by Prob. 6. and that sum will be the value of the longest life sought.

EXAMP. A is 18 years of age, B 34, and C 56: What is the value of the longest of these three lives, interest at 4 *per cent.?*

By the table, the single value of A's life is,	16.1
single value of B's life is,	14.12
single value of C's life is,	10.01
Sum of the single values,	40.23
By Prob. 2. the joint value of A and B is,	10.76
joint value of A and C is,	8.19
joint value of B and C is,	7.65
Sum of the joint lives,	26.60
Remainder,	13.63
By Prob. 6. the value of the 3 joint lives is,	6.54
Value of the longest of the 3 lives,	20.17

Other problems might be added, but these adduced are sufficient for most purposes. The reader probably may wish that the reason of the rules, which, it must be owned, are intricate, had been assigned; but this could not be done without entering deeper into the subject than was practicable in this place. See CHANCES.

ANNUITY *of tiends*, in Scots law, a certain proportion of the tiends of erected benefices formerly payable to the crown, but now gone into disuse.

ANNULAR, in a general sense, something in the form of, or resembling a ring. It is also a peculiar denomination for the fourth finger, commonly called the *ring-finger*.

ANNULATA, in zoology, an obsolete name of a species of coluber. See COLUBER.

ANNULET, in architecture, a small square member in the Doric capital, under the quarter-round.

Annulet is also a narrow flat moulding, which is common to divers places of the columns, as in the bases, capitals, *&c.* It is the same member which Vitruvius calls a *fillet*; Palladio, a *listel* or *cincture*; Scamozzi, and Mr Brown, a *supercilium*, *list*, *tinea*, *eye-brow*, *square*, and *rabbit*. See ARCHITECTURE.

ANNULET, in heraldry, a mark of distinction which the fifth brother of a family ought to bear to his coat of arms.

The hieroglyphic of the annulet is very various: Some

Some of the ancients used it to denote ſervitude; the Romans repreſented by it liberty and nobility. It is an emblem of ſecrecy, if it have a ſeal; and of love, if the cypher, the face, or the arms of the perſon beloved are ingraved upon it.

ANNULLING, a term ſometimes uſed for cancelling, or making void, a deed, ſentence, or the like.

ANNUNCIADA, ANNUNTIADA, or ANNUNTIATA, an order of knighthood in Savoy, firſt inſtituted by Amadeus I. in the year 1409; their collar was of 15 links, interwoven one with another, in form of a true lover's knot, and the motto, F. E. R. T. ſignifying, *Fortitudo ejus Rhodum tenuit*. Amadeus VIII. gave the name *Annunciada* to this order, which was formerly known by that of *the knot of love*, changing at the ſame time the image of St Maurice patron of Savoy, which hung at the collar, for that of the Virgin Mary, and, inſtead of the motto above-mentioned, ſubſtituting the words of the angel's ſalutation.

ANNUNCIADA is alſo the title of ſeveral religious orders, inſtituted at different times, and at different places, in honour of the annunciation. See the next article.

ANNUNCIATION, the tidings brought by the angel Gabriel to the Virgin Mary of the incarnation of Chriſt.

Annunciation is alſo a feſtival, kept by the church on the 25th of March, in commemoration of theſe tidings.

In the Romiſh church, on this feaſt, the pope performs the ceremony of marrying or cloyſtering a certain number of maidens, who are preſented to him in the church, clothed in white ſerge, and muffled up from head to foot: An officer ſtands by, with purſes containing notes of fifty crowns for thoſe who make choice of marriage, and notes of a hundred for thoſe who chuſe the veil.

Annunciation is likewiſe a title given by the Jews to part of the ceremony of the paſſover.

ANNUNTIATOR, the name of an officer in the church of Conſtantinople. It was his buſineſs to inform the people of the feſtivals that were to be celebrated.

ANOCTORON, a term uſed by ſome eccleſiaſtical writers for a church. See CHURCH.

ANOCISTI, in zoology, an obſolete name of the echinus. See ECHINUS.

ANODYNE, in pharmacy, a term applied to medicines which mitigate pain.

Among anodynes may be reckoned all relaxing remedies, diluters, and medicines which by any means deſtroy acrimony, or expel wind, together with the compound medicines of the ſhops, which paſs under this name; ſuch as the anodyne balſam made of Caſtile ſoap, opium, camphire, ſaffron, and ſpirit of wine.

ANOLYMPIADS, in Grecian antiquity, an appellation given by the Elæans to ſuch Olympic games as had been celebrated under the direction of other ſtates beſides themſelves. See OLYMPIAD.

ANOMOLISTICAL *Year*, in aſtronomy, the time that the earth takes to paſs through her orbit: it is alſo called the periodical year.

The ſpace of time belonging to this year is greater than the tropical year, on account of the preceſſion of the equinoxes. See PRECESSION, and ASTRONOMY.

ANOMALOUS, a term applied to whatever is irregular, or deviates from the rule obſerved by other things of the like nature.

ANOMALY, in aſtronomy, an irregularity in the motion of the planets, whereby they deviate from the aphelion or apogee.

ANOMIA, in zoology, a genus of ſhell-inſects belonging to the order of vermes teſtacea. The ligula is emarginated, and the cilii are fixed to the ſuperior valve; it has two lineal brachii longer than the body: The valves of the ſhell are equal. There are 25 ſpecies of the anomia; ſuch of them whoſe hiſtory is known, are all natives of the European ſeas.

ANOMOEANS, in church-hiſtory, ancient heretics, who aſſerted that the Son was of a nature different, and in nothing like to that of the Father.

ANOMORHOMBOIDIA, in natural hiſtory, a genus of cryſtalline ſpars, of no determinate form, eaſily fiſſile, but cleaving more readily in an horizontal than in a perpendicular direction, their plates being compoſed of irregular arrangements of ſhort and thick rhomboidal concretions. See SPAR.

ANONA, in botany, a genus of the polyandria polygynia claſs. The calix is three-leaved; the petals are ſix; the fruit is a roundiſh berry containing many ſeeds. There are 8 ſpecies of the anona, *viz*. the muricata, ſquamoſa, reticulata, paluſtris, glabra, triloba, Aſiatica, and Africana. All of them natives of the Indies.

ANONIS, in botany. See ONONIS.

ANONYMOS, in botany, a ſynonime of a ſpecies of ſpermacoce and ſeveral other plants. See SPERMACOCE.

ANONYMOUS, ſomething that is nameleſs, or of which the name is concealed.

ANONYMOUS, in chemiſtry. See ADIAPHOROUS.

ANOREXY, in medicine, a loathing of meat, or want of appetite.

ANOT. See ANNOT.

ANOTH, one of the Scilly iſlands. See SCILLY.

ANOUT, a ſmall iſland in the Schagerrack, or that part of the ſea of Denmark which has Norway on the north, Jutland on the weſt, and the iſle of Zealand on the ſouth; it lies in 13° E. long. and 56° 36′ N. lat.

ANSA, a river in Friuli in Italy, which diſcharges itſelf into the gulf of Venice.

ANSÆ, in aſtronomy, the parts of Saturn's ring, which are to be ſeen on each ſide of that planet, when viewed through a teleſcope. See ASTRONOMY.

ANSE, a ſmall town of France in the Lyonnois, four leagues north of Lyons.

ANSEL-WEIGHT, the ſame with auncel-weight. See AUNCEL.

ANSELM'*s Art*, or ST ANSELM'*s Art*. See ART.

ANSER, in ornithology, the trivial name of a ſpecies of ans. See ANS.

ANSERES, the name which Linnæus gives to his third order of birds. This order is diſtinguiſhed by the following marks: The beak is covered with a ſmooth ſkin

ſkin or membrane, wideſt at the apex, and full of ſmall holes like a ſieve; the toes of the feet are connected by a membrane which enables them to ſwim; the tibia, or ſhin-bone, is ſhort and flat. They live upon water-plants, fiſhes, *&c.* This order includes 12 genera, *viz.* the anas, mergus, phaeton, plotus, rhyncops, dromeda, alca, procellaria, pelecanus, larus, ſterna, and columbus. See theſe articles, and NATURAL HISTORY.

ANSER, in aſtronomy, a ſtar of the fifth or ſixth magnitude, in the milky-way, between the ſwan and eagle.

ANSES, in aſtronomy, the ſame with anſæ. See ANSÆ.

ANSIANACTES, a people of Africa, in the weſtern part of the iſle of Madagaſcar.

ANSLO, a ſea-port town of Norway, and province of Aggerhuys, ſituated in 10° 12′ E. long. and 59° 30′ N. lat.

ANSPACH, or OHNSPACH, a city of Germany, and circle of Franconia, ſituated in 10° 36′ E. long. and 49° 22′ N. lat.

It is the capital of the marquiſate of Anſpach, of which family was the late queen Caroline.

ANSPESSADES, in the French armies, a kind of inferior officer in the foot, below the corporals, but above the common centinels. There are uſually four or five of them in a company.

ANSTRUTHER *Eaſter* and *Weſter*, two royal burghs of Scotland, ſituated on the ſouth-eaſt coaſt of the county of Fife, in 2° 25′ W. long. and 56° 20′ N. lat.

ANT, in zoology. See FORMICA.

ANTA, in the ancient architecture, a ſquare pilaſter, placed at the corners of buildings.

ANTA, in geopraphy, a little city with a harbour, on the coaſt of Guinea in Africa.

ANTACHATES, in natural hiſtory, a bituminous ſtone, which yields a ſmell like myrrh, in burning.

ANTACIDS, in pharmacy, an appellation given to all medicines proper to correct acid or four humours: Such are the abſorbent and obtundent claſſes, *&c.*

ANTAGONIST, denotes an adverſary, eſpecially in ſpeaking of combats and games.

ANTAGONIST *muſcles*, in anatomy, thoſe which have oppoſite functions, as flexors and extenſors, abductors and adductors, *&c.*

ANTALIS, in zoology, the trivial name of a ſpecies of the dentalium. See DENTALIUM.

ANTALGICS, in medicine, the ſame with anodynes. See ANODYNE.

ANTANACLASIS, in rhetoric, a figure which repeats the ſame word, but in a different ſenſe; as, *dum vivimus, vivamus.*

ANTANAGOGE, in rhetoric, a figure by which, when the accuſation of the adverſary is unanſwerable, we load him with the ſame or other crimes.

ANTANISOPHYLLUM, in botany, a ſynonime of a ſpecies of Boerhaavia. See BOERHAAVIA.

ANTAPHRODISIACS, in pharmacy, medicines proper to diminiſh the ſemen, and conſequently extinguiſh or leſſen all deſires of venery.

ANTARCTIC, in a general ſenſe, denotes ſomething oppoſite to the arctic or northern pole. Hence, antarctic circle is one of the leſſer circles of the ſphere, and diſtant only 23° 30′ from the ſouth pole, which is likewiſe called antarctic for the ſame reaſon.

ANTARES, a ſtar of the firſt magnitude, otherwiſe called the *ſcorpion's heart.* See SCORPION.

ANTE′, in heraldry, denotes that the pieces are let into one another in ſuch form as is there expreſſed; as, for inſtance, by dove-tails, rounds, ſwallow-tails, or the like.

ANTEAMBULONES, in Roman antiquity, ſervants who went before perſons of diſtinction to clear the way before them. They uſed this formula, *Date locum domino meo,* i. e. Make room, or way, for my maſter.

ANTECEDENT, in general, ſomething that goes before another, either in order of time or place.

ANTECEDENT, in grammar, the word to which a relative refers.

ANTECEDENT, in logic, is the firſt of the two propoſitions in an enthymema.

ANTECEDENT, in mathematics, is the firſt of two terms of a ratio, or that which is compared with the other.

ANTECEDENT *ſigns*, in medicine, ſuch as are obſerved before a diſtemper is ſo formed as to be reducible to any particular claſs.

ANTECEDENCE, in aſtronomy, an apparent motion of a planet towards the weſt, or contrary to the order of the ſigns.

ANTECESSOR, one that goes before. It was an appellation given to thoſe who excelled in any ſcience: Juſtinian applied it particularly to profeſſors of civil law; and, in the univerſities of France, the teachers of law take the title *anteceſſores* in all their theſes.

ANTECURSORES, in the Roman armies, a party of horſe detached before, partly to get intelligence, proviſions, *&c.* and partly to chuſe a proper place to encamp in. Theſe were otherwiſe called *anteceſſores*, and by the Greeks *prodromi.*

ANTEDATE, among lawyers, a ſpurious or falſe date, prior to the true date of a bond, bill, or the like.

ANTEDILUVIAN, whatever exiſted before Noah's flood: Thus, the generations from Adam to Noah are called the *antediluvians.* See DELUGE.

ANTEGO, one of the Caribbee iſlands, in the Atlantic or American ocean, ſituated in 62° W. long. and 17° 30′ N. lat. It is about 20 miles long, and as many broad.

ANTEJURAMENTUM, by our anceſtors called *juramentum calumniæ*, an oath which anciently both accuſer and accuſed were to take before any trial or purgation.

The accuſer was to ſwear that he would proſecute the criminal; and the accuſed to make oath, on the day he was to undergo the ordeal, that he was innocent of the crime charged againſt him.

ANTELOPE, in zoology. See CAPRA.

ANTEMURALE, in the ancient military art, denotes much the ſame with what the moderns call an *outwork.*

ANTENCLEMA, in rhetoric, called by the Latins *relatio*, is when the fault is imputed, upon any misfortune happening, to the perſon to whom it happened.

ANTENNÆ, in the hiſtory of inſects, ſlender bodies with which nature has furniſhed the heads of theſe creatures, being the ſame with what in Engliſh are called *horns* or *feelers*.

ANTEPAGMENTA, in the ancient architecture, the jambs of a door. They are alſo ornaments, or garniſhings, in carved work, of men, animals, *&c.* made either of wood or ſtone, and ſet on the architrave.

ANTEPENULTIMA, in grammar, the third ſyllable of a word from the end, or the laſt ſyllable but two.

ANTEPILANI, in the Roman armies, a name given to the haſtati and principes, becauſe they marched next before the triarii, who were called *pilani*.

ANTEPILEPTICS, among phyſicians, medicines eſteemed good in the epilepſy.

ANTEPOSITION, in grammar, the placing a word firſt which ſhould ſtand laſt.

ANTEPREDICAMENTS, among logicians, certain preliminary queſtions which illuſtrate the doctrine of predicaments and categories.

ANTEQUIERA, a town of Granada, in Spain; ſituated in W. long. 4° 40′, and N. lat. 36° 40′, about 25 miles north of Malaga.

ANTEQUIRA-NOVA, an epiſcopal city of New Spain, in America, in the province of Guaxaca.

ANTERIDES, in the ancient architecture, buttreſſes erected to ſupport a wall. See BUTTRESS.

ANTERIOR, denotes ſomething placed before another, either with reſpect to time or place.

ANTEROTES, in natural hiſtory, a name given by the ancients to a ſpecies of amethyſt. See AMETHYST.

ANTESIGNANI, in the Roman armies, ſoldiers placed before the ſtandards, in order to defend them, according to Limpſius; but Cæſar and Livy mention the anteſignani as the firſt line, or firſt body, of heavy-armed troops. The velites, who uſed to ſkirmiſh before the army, were likewiſe called *anteſignani*.

ANTESTATURE, in fortification, a ſmall retrenchment made of paliſadoes, or ſacks of earth, with a view to diſpute with an enemy the remainder of a piece of ground

ANTEVIRGILIAN *huſbandry*, an appellation given to Mr Tull's new method of horſe-hoeing huſbandry. See AGRICULTURE, Part II.

ANTHAKIA, in geography, the ſame with Antioch. See ANTIOCH.

ANTHELIX, in anatomy, the inward protuberance of the external ear, being a ſemicircle within, and almoſt parallel to the helix. See p. 295.

ANTHELMINTICS, among phyſicians, medicines proper to deſtroy worms. See PHARMACY.

ANTHEM, a church-ſong, performed in cathedral ſervice by choriſters who ſung alternately.

ANTHEMIS, or CAMOMILE, in botany, a genus of the ſyngeneſia polygamia ſuperflua claſs. The receptacle of the anthemis is paleaceous; it has no pappus; the calix is globular. There are 18 ſpecies of anthemis, only five of which are natives of Britain, *viz.* the nobilis, or ſweet-ſcented camomile; the cotula, or ſtinking May-weed; the arvenſis, or corn-camomile; the maritima, or ſea-camomile; and the tinctoria, or common ox-eye. The flowers of the anthemis nobilis are carminative, emolient, and aperient.

ANTHERÆ, among botaniſts, the little roundiſh or oblong bodies on the tops of the ſtamina of plants. See STAMINA, and BOTANY.

ANTHERICUM, in botany, a genus of the hexandria monogynia claſs. The corolla has ſix petals open at the top; and the capſule is ovated. There are 13 ſpecies of anthericum, none of which are natives of Britain, except the calyculatum, or Scottiſh aſphodel.

ANTHESPORIA, in antiquity, a Sicilian feſtival, inſtituted in honour of Proſerpine.

ANTHESTERIA, in Grecian antiquity, feſtivals celebrated in the ſpring, by the ancient Athenians, in honour of Bacchus, during which the maſters feaſted their ſlaves, as the Romans did in the time of the Saturnalia.

ANTHESTERION, in ancient chronology, the ſixth month of the Athenian year, anſwering to the latter part of our November and beginning of December.

ANTHIAS, in ichthyology, the trivial name of a ſpecies of labrus. See LABRUS.

ANTHINE *wine*, among the ancients, a kind of wine medicated with the flowers of plants.

ANTHOCEROS, in botany, a genus of the cryptogamia claſs. The calix of the male is ſeſſile, cylindrical, and intire; the antheræ are very long, ſubulated, and two-valved; the calix of the female is divided into ſix pieces; the ſeeds are three. There are only three ſpecies of the anthoceros, *viz.* the punctatus, or ſpotted anthoceros, a native of Britain; the lævis, a native of Europe and America; and the multifidus, a native of Germany.

ANTHOLOGION, the title of the ſervice-book uſed in the Greek church.

It is divided into twelve months, containing the offices ſung throughout the year, on the feſtivals of our Saviour, the Virgin, and other remarkable ſaints.

ANTHOLOGY, a diſcourſe of flowers, or of beautiful paſſages from any authors.

ANTHOLOGY is alſo the name given to a collection of epigrams taken from ſeveral Greek poets.

ANTHOLYZA, a genus of the triandria monogynia claſs. The calix is tubular, irregular, and bent back; the capſule is below the flower. There are four ſpecies of the antholyza, *viz.* the ringens, a native of Æthiopia; the cunonia, a native of Perſia; the æthiopia, a native of Æthiopia; and the meriana, a native of the Cape of Good-Hope.

ANTHONY, or *Knights of* ST ANTHONY, a military order, inſtituted by Albert duke of Bavaria, Holland, and Zealand, when he deſigned to make war againſt the Turks in 1382. The knights wore a collar of gold, made in form of a hermit's girdle, from which hung a ſtick cut like a crutch, with a little bell, as they are repreſented in Anthony's pictures.

St ANTHONY's *fire*, a name ſometimes given to the eryſipelas. See ERYSIPELAS.

ANTHORA, in botany, the trivial name of a ſpecies of aconitum. See ACONITUM.

ANTHORISMUS, in rhetoric, denotes a contrary deſcription or definition of a thing from that given by the adverſe party.

ANTHOS, a Greek term, properly ſignifying a flower, but uſed by ſome writers to denote roſemary by way of eminence.

ANTHOS is ſometimes alſo uſed for the elixir of gold, as well as for a medicine extracted from pearls

ANTHOS *philoſophorum*, denotes a certain method of tranſmuting metals by vitriol.

ANTHOSATUM *acetum*, the vinegar of roſemary flowers.

ANTHOSPERMUM, in botany, a genus of the polygamia diœcia claſs. The calix of the hermaphrodite flower is divided into four parts; it has no corolla; the ſtamina are four, and the piſtilli two; the germen is below the flower. There are two ſpecies of anthoſpermum, *viz.* the æthiopicum, a native of Æthiopia; and the ciliare, a native of the Cape of Good-Hope.

ANTHOXANTHUM, in botany, a genus of the diandria digynia claſs. The calix is a bivalved gluma, with one flower; the corolla is bivalved, obtuſe, and without any awn. There are three ſpecies of anthoxanthum, *viz.* the odoratum, or ſpring-graſs, a native of Britain; the indicum, a native of India; and the paniculatum, a native of the ſouthern parts of Europe.

ANTHRACIS, ANTHRACIAS, or ANTHRACITIS, names promiſcuouſly uſed by ancient naturaliſts for very different foſſils, *viz.* the carbuncle, hæmatites, and a kind of aſteria. See CARBUNCLE, *&c.*

ANTHRACOSIS, in medicine, a corroſive ſcaly ulcer, either in the bulb of the eye or the eye-lids.

ANTHRAX, a Greek term, literally ſignifying a burning coal, uſed by the ancients to denote a gem, as well as a diſeaſe, more generally known by the name of carbuncle. See CARBUNCLE.

ANTHRAX is ſometimes alſo uſed for lithanthrax, or pit-coal. See LITHANTHRAX.

ANTHRISCUS, in botany, the trivial name of a ſpecies of tordylium See TORDYLIUM.

ANTHROPOGLOTTUS, among zoologiſts, an appellation given to ſuch animals as have tongues reſembling that of mankind, particularly to the parrot kind.

ANTHROPOGRAPHY, denotes the deſcription of the human body, its parts, ſtructure, *&c.* See ANATOMY.

ANTHROPOLATRÆ, in church-hiſtory, an appellation given to the Neſtorians, on account of their worſhipping Chriſt, notwithſtanding that they believed him to be a mere man.

ANTHROPOLATRIA, the paying divine honours to a man, ſuppoſed to be the moſt ancient kind of idolatry.

ANTHROPOLOGY, a diſcourſe upon human nature.

ANTHROPOLOGY, among divines, denotes that manner of expreſſion by which the inſpired writers attribute human parts and paſſions to God.

ANTHROPOMANCY, a ſpecies of divination, performed by inſpecting the intrails of a human creature.

ANTHROPOMORPHA, a term formerly given to the primates, or that claſs of animals which have the greateſt reſemblance to the human kind. See NATURAL HISTORY.

ANTHROPOMORHISM, among eccleſiaſtical writers, denotes the hereſy or error of the Anthropomorphites. See the next article.

ANTHROPOMORPHITES, in church-hiſtory, a ſect of ancient heretics, who, taking every thing ſpoken of God in ſcripture in a literal ſenſe, particularly that paſſage of Geneſis in which it is ſaid *God made man after his own image*, maintained, That God had a human ſhape They are likewiſe called *Audeans*, from Audeus their leader.

ANTHROPOMORPHOUS, an appellation given to whatever reſembles the human form.

ANTHROPOPATHY, a figure or expreſſion by which ſome paſſion is aſcribed to God, which properly belongs only to man.

ANTHROPOSCOPY, that part of phyſiognomy which judges of a man's character, *&c.* from the lineaments of his body.

ANTHROPOPHAGY, the act of eating human fleſh. This horrid practice is ſaid to prevail in ſome parts of Africa and America. But it is greatly to be doubted if ever ſuch a cuſtom exiſted.

ANTROPOTHYSIA, the inhuman practice of offering human ſacrifices. See SACRIFICE.

ANTHUM, in botany. See EPITHYMUM.

ANTHUS, in ornithology, a ſynonyme of the loſeia. See LOSEIA.

ANTHYLLUS, in botany, a genus of the diadelphia decandria claſs. The calix is ventricoſe, and the legumen is roundiſh. There are 10 ſpecies of anthyllus, *viz.* the tetraphylla, montana, cornicina, lotoides, barba jovis, heterophylla, cytiſoides, hermaniæ, and erinacea, all natives of Spain, Italy, and the ſouthern parts of Europe; and the vulneraria, kidney-vetch, or lady's finger, a native of Britain.

ANTHYPOPHORA, in rhetoric, a figure of ſpeech; being the counter-part of an hypophora. See HYPOPHORA.

ANTI, a Greek prepoſition, which enters into the compoſition of ſeveral words, both Latin, French, and Engliſh, in different ſenſes. Sometimes it ſignifies *before*, as in anti-chamber; and ſometimes *oppoſite* or *contrary*, as in the names of theſe medicines, antiſcorbutics, anti-venereal.

ANTIADES, in anatomy, a name ſometimes uſed for the glands, more uſually called *tonſils*. See p. 296.

ANTIDIAPHORISTS, in church-hiſtory, the oppoſers of the Adiaphoriſts. See ADIAPHORISTS.

ANTIBACCHIUS, in ancient poetry, a foot conſiſting of three ſyllables, the two firſt long, and the laſt one ſhort; ſuch is the word āmbīrĕ.

ANTIBES, a ſea-port town of Provence in France, ſituated on the Mediterranean, in E. long. 7°, N. lat. 43°, 40′.

ANTICARDIUM, in antiquity, the ſame with ſcrobiculum cordis.

ANTI-

ANTICHAMBER, an outer chamber for ſtrangers to wait in, till the perſon to be ſpoken with is at leiſure.

ANTICHRESIS, among civilians, the ſame with what in common law is called a *mortgage*. See MORTGAGE.

ANTICHRIST, among eccleſiaſtical writers, denotes a great adverſary of Chriſtianity, who is to appear upon the earth towards the end of the world. He is called in ſcripture, *The man of ſin, the man of perdition*, &c.

ANTICHTHONES, in ancient geography, an appellation given to the inhabitants of oppoſite hemiſpheres.

ANTICOR, or ANTICOEUR, among farriers, an inflammation in the horſe's throat, being the ſame with the quinzy in mankind.

ANTICOSTE, an American iſland, ſituated before the mouth of the river St Lawrence, in 64° W. long. and 49° 52′ N. lat.

ANTICUS, a term uſed by anatomiſts, importing, that the part with which it is joined ſtands before ſome others: Thus, we meet with ſerratus anticus, peronœus anticus.

ANTIDESMA, in botany, a genus of the diœcia pentandria claſs. The calix of the male conſiſts of 5 leaves; it has no corolla: The calix of the female is entire, gaping a little on one ſide; it has no corolla, but two ſtyli, and a double valved capſule incloſed in the calix. There is but one ſpecies of the antideſma, *viz.* the alexeteria, a native of India.

ANTIDICOMARIANITES, in church-hiſtory, heretics, who maintained that the Virgin Mary did not preſerve a perpetual virginity.

ANTIDOTE, among phyſicians, a remedy taken to prevent, or to cure the effects of poiſon, *&c.*

ANTIENT, or ANCIENT, a term applied to things which exiſted long ago: Thus we ſay, ancient nations, ancient cuſtoms, *&c.*

ANTIENT, in a military ſenſe, denotes either the enſign, or the colours.

ANTIENT, in ſhips of war, the ſtreamer or flag borne in the ſtern.

ANTIGONIA, the name of two cities, one in Epirus, now called *Caſtra Argiro*, the other in Macedon, now *Celogna*.

ANTIHECTICS, in pharmacy, medicines good in hectical diſorders.

ANTILLES, the ſame with the Caribbee iſlands.

ANTILOGARITHM, the complement of a logarithm.

ANTILOGY, in matters of literature, an inconſiſtency between two or more paſſages of the ſame book.

ANTILYSSUS *Pulvis*, a medicine conſiſting of equal parts of the lichen cinereus terreſtris, and black pepper, reckoned good to prevent the rabies canina.

ANTIMETABOLE, in rhetoric, a figure whereby two things are ſet in oppoſition to each other.

ANTIMONARCHICAL, an appellation given to whatever oppoſes monarchial government. See MONARCHY.

ANTIMONIALS, in medicine, preparations of antimony. See ANTIMONY, and CHEMISTRY.

ANTIMONIATED, ſomething impregnated with the virtues of antimony.

ANTIMONY, in natural hiſtory, one of the ſemi-metals. See CHEMISTRY, title, *Of metals*.

ANTINOMIANS, in church-hiſtory, certain heretics who firſt appeared about the year 1535; ſo called, becauſe they rejected the law, as of no uſe under the goſpel-diſpenſation, with other doctrines equally abſurd.

ANTIOCH, a town of Syria, formerly its capital, but now in a ruinous condition; ſituated on the river Orontes, in 37° E. long. and 36° N. lat.

ANTIOCHENUM, in botany, a ſpecies of convolvulus. See CONVOLVULUS.

ANTIPAGMENTA. See ANTEPAGMENTA.

ANTIPATHY, a natural averſion of one body to another, in contradiſtinction to ſympathy. See SYMPATHY.

ANTIPERISTALTIC *motion of the inteſtines*, the reverſe of the periſtaltic motion. See PERISTALTIC.

ANTIPERISTASIS, in the peripatetic philoſophy, an imaginary intention or heightening of any quality by the oppoſition of its contrary.

ANTIPHONY, in muſic, the name which the Greeks gave to that kind of ſymphony which was executed in octave or double octave. It is likewiſe the anſwer made by one choir to another, when an anthem is ſung between them.

ANTIPHRASIS, in rhetoric, a figure by which in ſaying one thing we mean the contrary. See IRONY.

ANTIPODES, in geography, a name given to thoſe inhabitants of the globe that live diametrically oppoſite to one another. They lie under oppoſite parallels, and oppoſite meridians. They have the ſame elevation of their different poles. It is midnight with the one, when it is noon-day with the other; the longeſt day with the one is the ſhorteſt with the other; and the length of the day with the one is equal to the night of the other. See GEOGRAPHY.

ANTIPOPE, in the Romiſh church, one elected pope in an irregular manner, in oppoſition to another.

ATIPTOSIS, in rhetoric, a figure which puts one caſe for another. See CASE.

ANTIQUARY, a perſon who ſtudies and ſearches after monuments and remains of antiquity.

There were formerly in the chief cities of Greece and Italy, perſons of diſtinction called antiquaries, who made it their buſineſs to explain the ancient inſcriptions, and give every other aſſiſtance in their power to ſtrangers who were lovers of that kind of learning. There is a ſociety of antiquaries in London, incorporated by the king's charter.

ANTIQUATED, ſomething obſolete, out of date, or out of uſe.

ANTIQUE, in a general ſenſe, ſomething that is ancient: but the term is chiefly uſed by ſculptors, painters, and architects, to denote ſuch pieces of their different arts as were made by the ancient Greeks and Romans. Thus we ſay, *an antique buſt, an antique ſtatue*, &c.

ANTIQUITY, ſignifies times or ages paſt long ago. Thus we ſay, *the heroes of antiquity*, &c. It is often uſed for the works or monuments of the ancients. Reſearches

ſearches into antiquity have frequently been uſeful. But theſe reſearches, unleſs they are conducted with judgment, are extremely liable to ridicule.

ANTIRRHINUM, in botany, a genus of the didynamia angioſpermia claſs. The calix conſiſts of five leaves; the baſis of the corolla is bent backwards, and furniſhed with pectoria; the capſule is bilocular. There are 14 ſpecies of the antirrhinum, 10 of which are natives of Britain, *viz.* the cymbalaria, or ivy-leaved toad-graſs; the elatine, or ſharp-pointed fluellin; the ſpurium, or round-leaved fluellin; the arvenſe, or corn-blue toad-flax; the repens, or creeping toad-flax; the monoſpermum, or ſweet-ſmelling toad-flax; the linaria, or common yellow toad-flax; the minus, or leaſt toad-flax; the majus, or greater ſnapdragon; and the orontium, or leaſt ſnapdragon. The linaria is ſaid to be cathartic and diuretic; but it is not uſed in the ſhops.

ANTISAGOGE, in rhetoric, the ſame with conceſſion. See CONCESSION.

ANTISCII, in geography, people who live on different ſides of the equator, whoſe ſhadows at noon are projected oppoſite ways. Thus the people of the north are Antiſcii to thoſe of the ſouth, the one projecting their ſhadows at noon toward the north pole, and the other toward the ſouth pole.

ANTISCORBUTICS, medicines good in ſcorbutical caſes.

ANTISEPTICS, among phyſicians, a denomination given to all ſubſtances that reſiſt putrefaction. Such as ſalts of all kinds, vinegar, myrrh, ſnake-root, pepper, *&c.*

ANTISTOECHON, in grammar, the uſing one letter inſtead of another, as *olli* for *illi.*

ANTISTROPHE, in grammar, a figure by which two things mutually depending on one another, are reciprocally converted; as *the ſervant of the maſter, the maſter of the ſervant.*

ANTISTROPHE, among lyric poets, that part of a ſong and dance in uſe among the ancients, which was performed before the altar, in returning from weſt to eaſt, in oppoſition to ſtrophe. See STROPHE, and ODE.

ANTITACTÆ, in church-hiſtory, a branch of Gnoſtics, who held, that God was good and juſt, but that a creature had created evil; and conſequently that it is our duty to oppoſe this author of evil, in order to avenge God of his adverſary.

ANTITHENAR, in anatomy, a name given to the adductor indicis. See p. 210.

ANTITHESIS, contraſt, or oppoſition of words or ſentiments; as,

Though gentle, yet not dull,
Strong without rage, without o'erflowing full.

ANTITHET, denotes either a quality or thing ſet in oppoſition to its contrary.

ANTITHETARIUS, in law, a perſon who endeavours to acquit himſelf by charging the accuſer with the ſame fact.

ANTITRAGUS *muſculus*, in anatomy, a muſcle of the ear. See p. 295. par. 5.

ANTITRINITARIANS, a general name given to all thoſe who deny the doctrine of the Trinity, and particularly to the Arians and Socinians.

ANTITYPE, among eccleſiaſtical writers, denotes a type correſponding to ſome other type or figure.

ANTIVARI, a ſea-port town of Albania, ſituated on the gulph of Venice, in 19° 40′ E. long. and 42° 10′ N. lat. It is ſubject to the Turks.

ANTIVETRIA, a province or ſubdiviſion of Terra Firma, in South America, lying ſouthwards of Carthagena.

ANTLER, among ſportſmen, a ſtart or branch of a deer's attire.

Brow-ANTLER, denotes the branch next the head; and, *Bez*-ANTLER, the branch next above the brow-antler.

ANTOECI, in geography, thoſe inhabitants of the earth who live under the ſame meridian, and at the ſame diſtance from the equator; the one toward the north, and the other toward the ſouth. Hence they have the ſame longitude; and their latitude is alſo the ſame, but of a different denomination. They are in the ſame ſemicircle of the meridian, but oppoſite in parallels. They have preciſely the ſame hours of the day and night, but oppoſite ſeaſons; and the night of the one is always equal to the day of the other.

ANTONIAN *Waters*, medicinal waters of Germany, very pleaſant to the taſte, and eſteemed good in many chronic and hypochondriac caſes.

ANTONIO, one of the Cape de Verd iſlands, ſubject to the Portugueſe, and ſituated in 26° W. long. and 18° N. lat.

ANTONOMASIA a form of ſpeech, in which, for a proper name, is put the name of ſome dignity, office, profeſſion, ſcience, or trade; or when a proper name is put in the room of an appellative. Thus a king is called his majeſty; a nobleman, his lordſhip. We ſay the philoſopher inſtead of Ariſtotle, and the orator for Cicero: Thus a man is called by the name of his country, a German, an Italian; and a grave man is called a Cato, and a wiſe man a Solomon.

ANTRIM, the moſt north-eaſt county of Ulſter, in the kingdom of Ireland. It is alſo the name of the chief town of the aforeſaid county, ſituated at the north end of Lochneah, in 6° 26′ W. long. and 54° 45′ N. lat.

ANTRUM, among anatomiſts, a term uſed to denote ſeveral cavities of the body; as the antrum highmorianum, or that in the maxillary or jaw-bone, *&c.* See p. 162. par. 2.

ANTWERP, a beautiful city of the Auſtrian Netherlands, and capital of the marquiſate of the ſame name. It ſtands on the eaſtern ſhore of the river Scheld, about 25 miles north of Bruſſels, and in 4° 15′ E. long. and 51° 15′ N. lat.

ANTYX, in antiquity, denotes the circumference, or outermoſt round of a ſhield.

ANVIL, an iron inſtrument on which ſmiths hammer or forge their work, and is uſually mounted on a firm wooden block.

ANUS, in anatomy, the extremity of the inteſtinum rectum, or orifice of the fundament. See p. 261. par. 2.

ANWEILLER, a ſmall city of France, in the Lower Alſace, upon the river Queich.

ANZAR, a city of Turqueſtan, near Catai, where Tamerlane died.

ANZERMA, a town of S. America, in the kingdom of Popajan, upon the river Cauca, ſituated in 47° W. long. and 4° S. lat.

ANZUGUI, a town in the iſland of Japan, upon the bay of Mecao.

AONIDES, in mythology, one of the many appellations of the muſes, ſo called from Aonia, a part of ancient Bœotia.

AORIST, among grammarians, a tenſe peculiar to the Greek language, comprehending all the tenſes, or rather expreſſing an action in an indeterminate manner, without any regard to paſt, preſent, or future.

AOUST, a town of Piedmont in Italy, capital of the duchy of the ſame name, ſituated about 50 miles north of Turin, in 7° 10′ E. long. and 45° 45′ N. lat.

APAGOGICAL *Demonſtration*, an indirect way of proof, by ſhewing the abſurdity of the contrary.

APALACHIAN *Mountains*, a ridge of mountains of N. America, lying weſtward of the Britiſh plantations, and extending from 30° to 40° N. lat.

APAMEA, or HAMA, a town of Syria, ſituated on the river Orontes, in 38° 30′ E. long. and 34° N. lat.

APAMEA is alſo the name of a town of Phrygia, upon the river Marſyas; of a town of Midia, confining upon Parthia; and of a town of Bithynia, called by the Turks *Myrlea*.

APANAGE, or APENNAGE, in the French cuſtoms, lands aſſigned by a ſovereign for the ſubſiſtence of his younger ſons, which revert to the crown upon the failure of male iſſue in that branch to which the lands are granted.

APARINE, in botany, a ſynonime of the utricularia and ſeveral other plants.

APATHY, a term in philoſophy, denoting an utter privation of paſſion, and an inſenſibility of pain. Thus the Stoics affected an entire apathy, ſo as not to be ruffled, or ſenſible of pleaſure or pain.

APATIZATIO, a law-term, ſignifying an agreement.

APATURIA, in Grecian antiquity, an Athenian feſtival, kept in honour of Bacchus. It was during this ſolemnity that the young people were regiſtered in the reſpective wards of their fathers.

APE, the Engliſh name of the ſimia or monkey. See SIMIA.

APELITES, Chriſtian heretics in the ſecond century, who affirmed that Chriſt received a body from the four elements, which at his death he rendered back to the world, and ſo aſcended into heaven without a body.

APENE, in antiquity, the chariot in which the images of the gods were carried on ſolemn occaſions.

APENNAGE, in the French cuſtoms. See APANAGE.

APENNINE, a vaſt ridge of mountains, which runs through the middle of all Italy, from Savona, to the very ſtreight that ſeparates Italy from Sicily.

APENRADE, a town of Sleſwic, or S. Jutland, ſituated on a bay of the Baltic ſea, in 10° E. long. and 55° N. lat.

APENZEL, a town of Switzerland, capital of the canton of the ſame name, and ſituated in 9° E. long. and 47° 30′ N. lat.

APEPSY, in medicine, denotes crudity, or a bad digeſtion.

APER, in zoology, a ſynonime of the ſus ſcrofa. See SUS.

APER is likewiſe a trivial name of a ſpecies of Zeus. See ZEUS.

APERIENTS, in the materia medica, an appellation given to ſuch medicines as facilitate the circulation of the humours by removing obſtructions.

The five greater aperient roots of the ſhops are ſmallage, fennel, aſparagus, parſley, and butcher's broom; as the five leſſer ones are graſs, madder, eryngo, capers, and chammoc.

APERTURE, the opening of any thing, or a hole or cleft in any continuous ſubject.

APERTURE, in geometry, the ſpace between two right lines which meet in a point and form an angle.

APERTURE, in optics, a round hole in a turned bit of wood or plate of tin, placed within the ſide of a teleſcope or microſcope, near to the object-glaſs, by means of which more rays are admitted, and a more diſtinct appearance of the object is obtained.

APERTURES, or APERTIONS, in architecture, are uſed to ſignify doors, windows, chimneys, *&c.*

APERTURA *tabularum*, in law-books, the breaking open a laſt will and teſtament.

APERTURA *feudi*, in the civil law, ſignifies the loſs of a feudal tenure, by default of iſſue to him to whom the feud was firſt granted.

APETALOSE, or APETALOUS, among botaniſts, an appellation given to ſuch plants as have no flower-leaves.

APEX, in antiquity, the creſt of a helmet, but more eſpecially a kind of cap worn by the flamens.

APEX, among grammarians, denotes the mark of a long ſyllable, falſely called a long accent.

APHACA, in botany, a ſynonime of the lathyrus. See LATHYRUS.

APHÆRESIS, in grammar, a figure by which a letter or ſyllable is cut off from the beginning of a word.

APHÆRESIS, that part of ſurgery which teaches to take away ſuperfluities.

APHANES, in botany, a genus of the tetrandria digynia claſs. The calix is divided into eight parts; it has no corolla; and has two naked ſeeds. There is only one ſpecies of aphanes, *viz.* the arvenſis, or parſley-piert, a native of Britain.

APHELIUM, or APHELION, in aſtronomy, is that point in any planet's orbit, in which it is furtheſt diſtant from the ſun, being that end of the greater axis of the elliptical orbit of the planet moſt remote from the focus where the ſun is.

APHIS, in zoology, a genus of inſects belonging to the order of inſecta hemiptera. The roſtrum or beak of the aphis is inflected; the antennæ or feelers are longer than the thorax; it has four erect wings; the feet are of the ambulatory kind; and the belly often ends in two horns. There are 33 ſpecies of the aphis, all of

of which are inhabitants of particular plants; and from this circumſtance their trivial names are taken; as aphis ribis, ulmi, roſæ, *&c.*

APHORISM, a maxim, or principle, of a ſcience; or a ſentence which comprehends a great deal in a few words.

APHRATIC, in the maritime affairs of the ancients, were open veſſels, without any decks.

APHRODISIA, in antiquity, feſtivals kept in honour of Venus, the moſt remarkable of which was that celebrated by the Cyprians.

APHRODISIACS, among phyſicians, medicines which increaſe the quantity of ſeed, and create an inclination to venery.

APHRODITA, in zoology, an inſect of the order of vermes molluſca. The body of the aphrodita is oval, with many ſmall tentacula or protuberances on each ſide, which ſerve as ſo many feet: The mouth is cylyndrical, at one end of the body, and capable of being retracted, with two briſtly tentacula. There are four ſpecies of this inſect, *viz.* 1. The aculeata, with 32 tentacula, or feet, an inhabitant of the European ſeas. See Plate XXII. fig. 4. This figure is taken from the life. It was found on the ſhore of the frith of Forth, about a mile eaſt from Leith, by Dr Letſom, and by him communicated to the proprietors of this work. Johnſton, Seba, and other authors, have given figures of the aphrodita; but they are not ſo accurate as could be wiſhed. 2. The ſcabra, of an oblong ſhape, ſcabrous on the back, with about 20 tentacula. 3. The ſquamata, with 24 feet, and ſcaly on the back. 4. The imbricata, is very like the former, only its ſcales are more glabrous.

APHRODITES, the ſame with gemma veneris. See GEMMA.

APHRONITRE, in natural hiſtory, a name given by the ancients to a particular kind of natrum.

APHTHÆ, in medicine, ſmall, round, and ſuperficial ulcers ariſing in the mouth. The principal ſeat of this diſeaſe, is the extremity of the excretory veſſels, ſalival glands, and, in ſhort, all glands that furniſh a humour like the ſaliva, as the lips, gums, *&c.*

APHUA *cobites*, in ichthyology. See GOBIUS.

APHYLLANTHES, or *Blue Montpelier* PINK, in botany, a genus of the hexandria monogynia claſs. There is but one ſpecies, *viz.* the monſpelienſis, which grows in the high grounds near Montpelier. It is extremely like the juncus, only the flower has a corolla.

APIARY, a place where bees are kept.

APIASTELLUM, or APIASTRUM, in botany. See MELISSA.

APIASTER, in ornithology, the trivial name of a ſpecies of the merops. See MEROPS.

APICES, in botany, the ſame with antheræ. See ANTHERÆ.

APIOS, it botany. See GLYCINE.

APIS, or the BEE, in zoology, a genus of inſects belonging to the order of inſecta hymenoptera. The mouth is furniſhed with two jaws, and a proboſcis infolded in a double ſheath; the wings are four in number, the two foremoſt covering thoſe behind when at reſt: In the anus or tail of the females and working bees, which are of no ſex, there is a hidden ſting. Linnæus enumerates no leſs than 55 ſpecies of the apis, *viz.* 1. The longicornis, or hairy yellow bee, with thread-like feelers, about the length of its body. 2. The tumulorum, or black bee, with yellow feet and jaws, and thread-like feelers, about the length of the body. 3. The clavicornis, or black bee, with clavated feelers, about the length of its body, and two yellow belts round the belly. 4. The centuncularis, or black bee, having its belly covered with yellow down. The neſts of this ſpecies are made of roſe-leaves curiouſly plaited in the form of a matt or quilt. 5. The cineraria, or black bee, with a white hairy breaſt, and a greeniſh belt round the belly. The above five ſpecies are all natives of Europe. 6. The mexicana, is a browniſh bee, with bluiſh wings, and very large. It is a native of America. 7. The carbonaria, or reddiſh bee, with darkiſh green wings; it is about the ſize of the mellefica, or common honey-bee, and is found in Africa. 8. The retuſa, or black bee, has its legs covered with down. 9. The rufa, or browniſh bee, with a white front and duſky belly. 10. The bicornis, has two horns on its front, a black head, and a hairy belly. 11. The maxilloſa, or black bee, with prominent jaws, ſhort feelers, and a cylindrical belly, covered with a yellow down. 12. The truncorum, or black ſmooth bee, with a white hairy front, and a yellow belly edged with white. 13. The floriſomnis, or black bee, with a cylindrical incurvated belly, having two tooth-like protuberances at the anus, and a kind of prickles on the hind-legs. This bee ſleeps in flowers. 14. The dentata, or ſhining green bee, with black wings, and a kind of teeth on the hind thighs. The tongue of this bee is almoſt as long as its body. The nine laſt ſpecies are all natives of Europe. 15. The cordata, or ſhining green bee, with a belly ſhaped like a heart, and wings of a glaſs-colour. It is a native of the Indies. 16. The helvola, is an oblong reddiſh bee, with a white belly. 17. The fabriciana, or black bee, with an iron-coloured belly, and two yellow ſpots. 18. The ſuccincta, has a yellow hairy breaſt, a black belly, and four white belts. The laſt three are natives of Europe. 19. The zonata, is browniſh and hairy, with four bluiſh belts on the belly. It is a native of the Indies. 20. The ænea, is hairy, and of a copper colour. 21. The cæruleſcens, is browniſh and hairy, with a greeniſh belly, margined with white indentations.

22. The *mellefica*, or honey-bee, is furniſhed with downy hairs, a duſky-coloured breaſt, and browniſh belly; the tibiæ of the hind-legs are ciliated, and tranſverſely ſtreaked on the inſide. Each foot of this bee terminates in two hooks, with their points oppoſite to each other; in the middle of theſe hooks there is a little thin appendix, which, when unfolded, enables the bees to faſten themſelves to glaſs or the moſt poliſhed bodies. This part they likewiſe employ for collecting the ſmall particles of wax which they find upon flowers, and for tranſmitting them to the middlemoſt joint of the two hinder feet, in which there is a little cavity, in the ſhape of a narrow ſpoon, ſurrounded by a number of hairs. When they have loaded their thighs with wax, they immediately carry it off to the hive.

hive. The queen and drones, who never collect wax in this manner, have no such cavity. The belly of the bee is divided into six rings or joints. In the inside of the belly there is a small bladder or reservoir, in which the honey is collected, after having passed through the proboscis and a narrow pipe which runs through the head and breast. This bladder, when full of honey, is about the size of a small pea. The sting is situate at the extremity of the belly: It is a horny substance, and hollow within, for transmitting the venomous liquor, which lies in a bladder near the anus, into the wound. The sting is generally left in the wound, and frequently draws after it the poison-bag.

As the mellefica, or honey-bee, is both an useful insect, and endowed with peculiar instincts, we shall give a particular account of its nature and œconomy.

The queen is the only female in a hive; she is distinguished from the others by being taller, more of an oblong figure, and having ten joints in each feeler. She is likewise furnished with a sting. The fuci, males, or drones, are commonly about 1600 in a hive; they have no sting, and their feelers have eleven joints. The operariæ, spadones, or working bees, are sometimes 20,000 in a hive; they have fifteen joints in their feelers, and are armed with stings.

After a new swarm is formed, the bees immediately begin to form their cells. They begin their work at the upper part of the hive, and continue it downwards, and from one side to the other. It is not easy to discover the particular manner of their working; for, notwithstanding the many contrivances used for this purpose, there are such numbers in continual motion, and succeed one another with such rapidity, that nothing but confusion appears to the sight. Some of them however have been observed carrying pieces of wax in their talons, and running to the places where they are at work, upon the combs. These they fasten to the work by means of the same talons. Each bee is employed but a very short time in this way; but there is so great a number of them that go on in a constant succession, that the comb increases very perceptibly. Besides these, there are others that run about beating the work with their wings and the hinder part of their body, probably with a view to make it more firm and solid.

The order they observe in the construction of their cells is this: They begin with laying the basis, which is composed of three rhombus's or lozenges. They build first one of the rhombus's, and draw faces on two of its sides; they then add a second rhombus to the first in a certain inclination, and draw two new faces on its two sides; and, last of all, they add a third rhombus to the two first, and raise on the two external sides of this rhombus two other faces; which completes the cell of an hexagonal figure.

Whilst part of the bees are occupied in forming the cells, others are employed in perfecting and polishing those that are new-modelled. This operation is performed by their talons, taking off every thing that is rough and uneven. These polishers are not so desultory in their operations as those that make the cells; they work long and diligently, never intermitting their labour, excepting to carry out of the cell the particles of wax which they take off in polishing. These particles are not allowed to be lost; others are ready to receive them from the polishers, and to employ them in some other part of the work.

Each comb has two rows of cells opposite to each other, which have their common bases. The thickness of every comb is something less than an inch, and the depth of the cells is about five lines. Almost all the combs are built with cells of this size; except a small number of a larger kind, that are destined for the worms that produce drones.

The bases of all the combs are placed at such a distance from one another, that, when the cells are finished, there is only a space left sufficient for the passage of two bees abreast. These combs are not continued from top to bottom, but are often interrupted, and have openings from one passage to another, which give a more easy and shorter communication.

The queen-bee is generally concealed in the most secret part of the hive, and is never visible but when she lays her eggs in such combs as are exposed to sight. When she does appear, she is always attended by ten or a dozen of the common sort, who form a kind of retinue, and follow her where-ever she goes with a sedate and grave tread. Before she lays her eggs, she examines the cells where she designs to lay them; and if she finds that they contain neither honey, wax, nor any embrio, she introduces the posterior part of her body into a cell, and fixes to the bottom of it a small white egg, which is composed of a thin white membrane, full of a whitish liquor. In this manner she goes on, till she fills as many cells as she has eggs to lay, which are generally many thousands. After the eggs lie four days in the cells, they appear in the form of small caterpillars; and generally lie twisted round, so that the two extremities touch each other. The bees then supply them with a little honey for food, the quantity of which they increase till the eighth day from the birth of the caterpillar. After this, the bees discover no more care about their young; but stop up the mouths of the cells with wax. The embrios lie in this state twelve days, during which time they undergo surprising changes. They first change their situation in the cells, and instead of being rolled up, they extend themselves along, and place their heads towards the mouth of the cell; after this, the head of the worm begins to have a small extension, which is the rudiment of the proboscis: Upon the head there is likewise a black point, and at a little distance from this point, a black streak upon the back: The first lineaments of the feet likewise appear; but they are very small. After the head is formed, and the proboscis lengthened, all the other parts display themselves successively; so that the whole worm or embrio is changed into an aurelia or nymph, which is the fly almost perfect, except that it is yet white and soft, and wants that crust with which it is afterwards covered. By this transformation the worm is stripped of a white thin pellicle, which adheres to the sides of the cell. The young bee being stripped of this pellicle, and all the parts being unfolded by degrees, and changed through successive colours from yellow to black, arrives

at

Plate XXII.

Fig. 1. ANGUIS MELEAGRIS

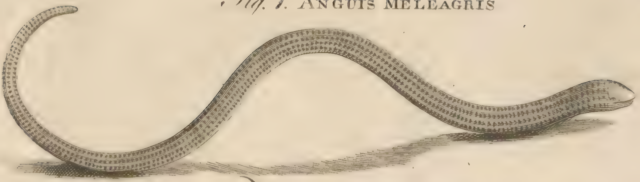


Fig. 2. ANGUIS MACULATA

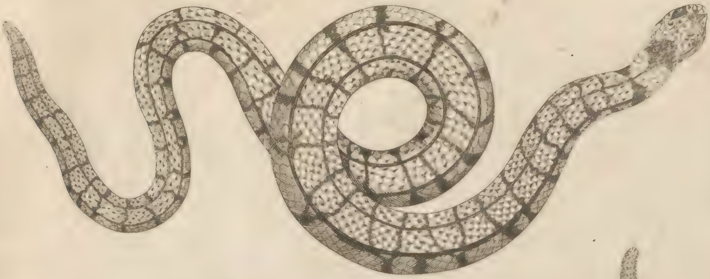


Fig. 3. ANGUIS SCYTALE

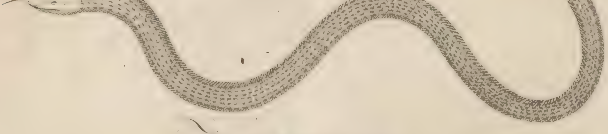


Fig. 4. APHRODITA

A Bell Sculp.

at perfection on the twentieth day; when ſhe cuts, with her jaws or talons, the covering of wax upon the mouth of the cells, and iſſues out. When the young bees firſt get out of the cell, they appear drowſy, but ſoon acquire agility and command of their members; for they have often been obſerved to go to the fields, and return loaded with wax the ſame day that they iſſued from the cells.

As ſoon as a young bee quits its cell, one of the old ones takes off the wax-cover, and kneads and employs the wax for ſome other purpoſe: Another of them repairs and cleanſes the cell, removing the pellicle and other ſordes which was left by the young one.

It was obſerved above, that bees collect their wax from the pollen or farina of flowers, and carry it to the hive. When they arrive there, they ſupport themſelves on their two fore-feet, and make a buzz with their wings, thereby warning the bees within to aſſiſt them to unload; which they inſtantly do, each taking a ſmall portion of the wax from the hinder-legs of the loaded ones, till the whole be exhauſted. The wax is not only employed for the original conſtruction of the combs and cells, but is collected and laid up in conſiderable quantities for the purpoſes of repairing any damage that may happen to the works during the winter, when they have no opportunity of collecting it in the fields, and likewiſe to ſtop up the mouths of the cells when full of honey or embrios. Bees have often been obſerved to dilute their wax, when too hard, by means of ſome liquor or ſaliva which they emit upon it, in order to render it ſoft and pliable for uſe.

The honey, as well as the wax, is collected from flowers. The honey, however, is extracted from a different part of the flower. In the flowers of many plants there are nectaria, or nectariferous glands, which ſecret from the plant a pure tranſparent liquor, reſembling virgin-honey both in taſte and appearance, excepting that it is thinner. Perhaps all the change that this nectariferous juice undergoes, by being ſucked up, and depoſited in the honey-bag of the bee, is, that the more watery parts may probably be abſorbed during the ſmall time it remains there. The heat of the hive, after it is depoſited in the cells, will ſtill evaporate more of the watery parts, and bring it to the conſiſtence of honey.

When a bee is collecting honey, ſhe no ſooner lights upon a flower than ſhe extends her proboſcis, and ſucks up what ſhe can find: If ſhe cannot find a ſufficient quantity to fill her bag in one flower, ſhe immediately flies to another, and thus goes on till ſhe has filled it. She then retires to the hive, goes to the cell, diſgorges the honey, and again returns to the fields in queſt of more. As the quantity carried home by one bee is but ſmall, it requires the labour of many to fill a cell with honey. When the cells are full, they are immediately cloſed up with wax, if deſigned for winter-proviſion; if not, they are allowed to remain open for the common nouriſhment of the ſwarm

Beſides theſe capital inſtincts of bees, they are poſſeſſed of others, ſome of which are equally neceſſary for their preſervation and happineſs. They anxiouſly provide againſt the entrance of inſects into the hive, by gluing up with wax the ſmalleſt holes in the ſkep. Some ſtand as centinels at the mouth of the hive, to prevent inſects of any kind from getting it. But if a ſnail, or other large inſect, ſhould get in, notwithſtanding all reſiſtance, they ſting it to death, and then cover it over with a coat of wax, to prevent the bad ſmell or maggots which might proceed from the putrefaction of ſuch a large animal. Bees are ſeldom overtaken with bad weather; they ſeem to be warned of its appearance by ſome particular feeling. Cold is a great enemy to them. To defend themſelves againſt its effects during a cold winter, they croud together in the middle of the hive, and buzz about, and thereby excite a warmth which is often perceptible by laying the hand upon the glaſs-windows of the hive. They ſeem to underſtand one another by the motions of their wings. When the queen wants to quit the hive, ſhe gives a little buzz, and all the others immediately follow her example, and retire along with her. They expell the drones before the winter, ſo that, of ſeveral hundreds in a hive, not one can be ſeen after the month of October. This expulſion always occaſions a furious battle between the drones and the working bees; but the latter being greatly ſuperior in number, always prevail.

With regard to Hives, thoſe made of ſtraw are the beſt, on many accounts: They are not liable to be overheated by the rays of the ſun; they keep out cold better than wood or any other materials; and the cheapneſs renders the purchaſe of them eaſy. As the ingenious Mr Wildman's hives are reckoned to be of a preferable conſtruction to any other, we ſhall give an account of them in his own words.

"My hives," ſays he, "are ſeven inches in height, "and ten in width. The ſides are upright, ſo that the "top and bottom are of the ſame diameter. A hive "holds nearly a peck. In the upper row of ſtraw, there "is a hoop of about half an inch in breadth, to which "are nailed five bars of deals, full a quarter of an inch "in thickneſs, and an inch and quarter wide, and half "an inch aſunder from one another; a narrow ſhort "bar is nailed at each ſide, half an inch diſtant from "the bars next them, in order to fill up the remaining "parts of the circle; ſo that there are in all ſeven bars "of deal, to which the bees fix their combs. The ſpace "of half an inch between the bars allows a ſufficient and "eaſy paſſage for the bees from one hive to another. In "order to give great ſteadineſs to the combs, ſo that, up-"on moving the hive, the combs may not fall off, or "incline out of their direction, a ſtick ſhould be run "through the middle of the hive, in a direction directly "a croſs the bars, or at right angles with them. When "the hives are made, a piece of wood ſhould be worked "into the lower row of ſtraw, long enough to allow "a door for the bees, of four inches in length, and "half an inch in height.

"The proprietor of the bees ſhould provide himſelf "with ſeveral flat covers of ſtraw, worked of the ſame "thickneſs as the hives, and a foot in diameter, that ſo "it may be of the ſame width as the outſide of the hives. "Before the cover is applied to the hive, a piece of "clean paper, of the ſize of the top of the hive, ſhould "be laid over it, and a coat of cow-dung, which is the "leaſt

" least apt to crack of any cement easily to be obtained, " should be laid all round the circumference of the hive. " Let the cover be laid upon this, and made fast to the " hive with a packing-needle and pack-thread, so that " neither cold nor vermin may enter.

" Each hive should stand single on a piece of deal, or " other wood, somewhat larger than the bottom of the " hive: That part of the stand which is at the mouth of " the hive should project some inches, for the bees to rest " on when they return from the field. This stand should " be supported upon a single post, two and a half feet " high; to which it should be screwed very securely, " that high winds, or other accidents, may not blow " down both stand and hive. A quantity of soot mixed " with barley-chaff should be strewed on the ground " round the post, which will effectually prevent ants, " slugs, and other vermin, from rising up to the hive. " The soot and chaff should, from time to time, be re- " newed as it is blown or washed away: Though, as it " is sheltered by the stand, it remains a considerable time, " especially if care be taken that no weeds rise through " it. Weeds, indeed, should not be permitted to rise " near the hive, for they may give shelter to vermin " which may be hurtful to the bees.

" The stands for bees should be four yards asunder; " or, if the apiary will not admit of so much, as far a- " sunder as may be, that the bees of one hive may not " interfere with those of another hive, as is sometimes " the case, when the hives are near one another, or on " the same stand: For the bees, mistaking their own " hives, light sometimes at the wrong door, and a fray " ensues, in which one or more may lose their lives.

" The person who intends to erect an apiary, should " purchase a proper number of hives at the latter part of " the year, when they are cheapest. The hives should " be full of combs, and well stored with bees. The " purchaser should examine the combs, in order to know " the age of the hives. The combs of that season are " white, those of the former year are of a darkish yel- " low; and where the combs are black, the hives should " be rejected, because old hives are most liable to ver- " min and other accidents.

" If the number of hives wanted were not purchased in " the autumn, it will be necessary to remedy this neglect " after the severity of the cold is past in the spring. At " this season, bees which are in good condition will get " into the fields early in the morning, return loaded, " enter boldly, and do not come out of the hive in bad " weather; for when they do, this indicates they are " in great want of provisions. They are alert on the " least disturbance, and by the loudness of their humming " we judge of their strength. They preserve their hives " free from all filth, and are ready to defend it against " every enemy that approaches.

" The summer is an improper time for buying bees, " because the heat of the weather softens the wax, and " whereby renders the combs liable to break, if they are " not very well secured. The honey too being then " thinner than at other times, is more apt to run out " of the cells; which is attended with a double disad- " vantage, namely, the loss of the honey, and the daub- " ing of the bees, whereby many of them may be de- " stroyed. A first and strong swarm may indeed be " purchased; and, if leave can be obtained, permitted " to stand in the same garden till the autumn; but if " leave is not obtained, it may be carried away in the " night after it has been hived.

" I suppose, that in the stocks purchased, the bees " are in hives of the old construction. The only direc- " tion here necessary is, that the first swarm from these " stocks should be put into one of my hives; and that " another of my hives should in a few days be put under " the old stock, in order to prevent its swarming again."

Bees never swarm till the hive be too much crouded by the young brood. It is this circumstance that induces a part of the hive to think of finding a more commodious habitation. With this view they single out a queen from among the young, with whom they take wing; and where-ever she leads, the rest follow. They first begin to swarm in May, or in the end of April, but earlier or later according to the warmth of the season. They seldom swarm before ten in the morning, and seldom later than three in the afternoon. We may know when they are about to swarm, by clusters of them hanging on the outside of the hive, and by the drones appearing abroad more than usual: But the most certain sign is, when the bees refrain from flying into the fields, though the season be inviting. Just before they take flight, there is an uncommon silence in the hive; after this, as soon as one takes flight, they all follow. Before the subsequent swarmings, there is a great noise in the hives, which is supposed to be occasioned by a contest whether the young or the old queen should go out. When the bees of a swarm fly too high, they are made to descend lower, by throwing handfuls of sand or dust among them, which they probably mistake for rain. For the same purpose, it is usual to beat on a kettle or frying-pan; This practice may have taken its rise from observing that thunder or any great noise prompts such bees as are in the fields to return home.

When the bees settle in swarming, they collect themselves in a heap, and hang to each other by their feet. When they settle in two separate divisions, it generally proceeds from there being two queens in the swarm. In that case, each cluster of them may be hived separately; or one of the queens must be destroyed, to prevent the commotions which the bees would raise in order to destroy her. All the motions and settling of a swarm are directed by the queen. If she be weak, and fall to the ground, the whole swarm fall down along with her; if she rest upon a branch of a tree, they accompany her; and if the queen be caught into a hive, the swarm will instantly follow her. When a swarm is too few in number for a hive, another may be added, provided the queen belonging to it be destroyed. If that precaution be not taken, a battle will ensue, in which not only one of the queens is killed, but frequently a great many of the working bees.

Several methods of taking the wax and honey, without destroying the bees, have of late been practised. Mr Wildman's seems both to be the easiest and safest: " Re- " move (says he) the hive from which you would take " the

" the wax and honey into a room, into which admit but " little light, that it may appear at first to the bees as if " it was late in the evening. Gently invert the hive, " placing it between the frames of a chair, or other " steady support, and cover it with an empty hive, keep- " ing that side of the empty hive raised a little which is " next the window, to give the bees sufficient light to " get up into it. While you hold the empty hive, stea- " dily supported on the edge of the full hive, between " your side and your left arm, keep striking with the " other hand all round the full hive from top to bottom, " in the manner of beating a drum, so that the bees " may be frightened by the continued noise from all " quarters; and they will in consequence mount out of " the full hive into the empty one. Repeat the strokes " rather quick than strong round the hive, till all the " bees are got out of it, which in general will be in a- " bout five minutes. It is to be observed, that the fuller " the hive is of bees, the sooner they will have left it. " As soon as a number of them have got into the empty " hive, it should be raised a little from the full one, " that the bees may not continue to run from the one to " the other, but rather keep ascending upon one another.

" So soon as all the bees are out of the full hive, the " hive in which the bees are must be placed on the stand " from which the other hive was taken, in order to " receive the absent bees as they return from the fields.

" If this is done early in the season, the operator " should examine the royal cells, that any of them that " have young in them may be saved, as well as the combs " which have young bees in them, which should on no " account be touched, though, by sparing them, a good " deal of honey should be left behind. Then take out " the other combs with a long, broad, and pliable knife, " such as the apothecaries make use of. The combs " should be cut from the sides and crown, as clean " as possible, to save the further labour of the bees, " who must lick up the honey spilt, and remove eve- " ry remains of wax; and then the sides of the hive " should be scraped with a table-spoon, to clear away " what was left by the knife. During the whole of this " operation, the hive should be placed inclined to the " side from which the combs are taken, that the honey " which is spilt may not daub the remaining combs. If " some combs were unavoidably taken away, in which " there are young bees, the parts of the combs in which " they are should be returned into the hive, and secured " by sticks, in the best manner possible. Place the hive " then for some time upright, that any remaining ho- " ney may drain out. If the combs are built in a di- " rection opposite to the entrance, or at right angles " with it, the combs which are the furthest from the " entrance should be preferred, because there they are " best stored with honey, and have the fewest young bees " in them.

" Having thus finished taking the wax and honey, " the next business is to return the bees to their old " hive; and for this purpose place a table, covered " with a clean cloth, near the stand, and giving the " hive in which the bees are a sudden shake, at the same " time striking it pretty forcibly, the bees will be shaken " on the cloth. Put their own hive over them imme- " diately, raised a little on one side, that the bees may " the more easily enter; and when all are entered, place " it on the stand as before. If the hive in which the " bees are, be turned bottom uppermost, and their own " hive be placed over it, the bees will immediately ascend " into it, especially if the lower hive is struck on the " sides to alarm them.

" The chief object of the bees during the spring and " beginning of summer, is the propagation of their kind. " Honey during that time is not collected in such quanti- " ties as it is afterwards: and on this account it is " scarcely worth while to rob a hive before the latter " end of June; nor is it safe to do it after the middle " July, lest rainy weather prevent their restoring the " combs they have lost, and laying in a stock of honey " sufficient for the winter, unless there is a chance of " carrying them to a rich pasture."

Mr Wildman, by his dexterity in the management of bees, has lately surprised the whole kingdom. He can order a swarm to light where he pleases, almost instantaneously; he can order them to settle on his head, then remove them to his hand; command them to depart and settle on a window, table, *&c.* at pleasure. We shall subjoin his method of performing these feats, in his own words: " Spectators (says he) wonder much at my at- " taching bees to different parts of my body, and wish " much to be possessed of the secret means by which I " do it. I have unwarily promised to reveal it; and am " therefore under a necessity of performing that promise: " but while I declare, that their fear and the queen are " the chief agents in these operations, I must warn my " readers that there is an art necessary to perform it, " namely practice, which I cannot convey to them, and " which they cannot speedily attain; yet till this art is " attained, the destruction of many hives of bees must " be the consequence; as every one will find on their " first attempt to perform it.

" Long experience has taught me, that as soon as I " turn up a hive, and give it some taps on the sides and " bottom, the queen immediately appears, to know the " cause of this alarm; but soon retires again among her " people. Being accustomed to see her so often, I readily " perceive her at first glance; and long practice has en- " abled me to seize her instantly, with a tenderness that " does not in the least endanger her person. This is of " the utmost importance; for the least injury done to her " brings immediate destruction to the hive, if you have " not a spare queen to put in her place, as I have too " often experienced in my first attempts. When pos- " sessed of her, I can, without injury to her, or exci- " ting that degree of resentment that may tempt her " to sting me, slip her into my other hand, and, return- " ing the hive to its place, hold her there, till the bees " missing her, are all on wing, and in the utmost confu- " sion. When the bees are thus distressed, I place the " queen where-ever I would have the bees to settle. The " moment a few of them discover her, they give notice " to those near them, and those to the rest; the know- " ledge of which soon becomes so general, that in a few " minutes they all collect themselves round her; and are

" so

" ſo happy in having recovered this ſole ſupport of their " ſtate, that they will long remain quiet in their ſituation. " Nay, the ſcent of her body is ſo attractive of them, " that the ſlighteſt touch of her, along any place or ſub- " ſtance, will attach the bees to it, and induce them to " purſue any path ſhe takes.

" My attachment to the queen, and my tender regard " for her precious life, makes me moſt ardently wiſh that " I might here cloſe the detail of this operation, which, " I am afraid, when attempted by unſkilful hands, will " coſt many of their lives; but my love of truth forces " me to declare, that, by practice, I am arrived at ſo " much dexterity in the management of her, that I can, " without hurt to her, tie a thread of ſilk round her " body, and thus confine her to any part in which ſhe " might not naturally wiſh to remain; or I ſometimes " uſe the leſs dangerous way of clipping her wings on " one ſide.

" I ſhall conclude this account in the manner of C. " Furius Creſinus, who being cited before the Curule " Edile and an aſſembly of the people, to anſwer to a " charge of ſorcery, founded on his reaping much larger " crops from his ſmall ſpot of ground, than his neigh- " bours did from their extenſive fields, produced his " ſtrong implements of huſbandry, his well-fed oxen, " and a hale young woman, his daughter; and, point- " ing to them, ſaid, Theſe, Romans, are my inſtru- " ments of witchcraft; but I cannot ſhew you my toil, " my ſweats, and anxious cares. So may I ſay, Theſe, " Britons, are my inſtruments of witchcraft; but I " cannot ſhew you my hours of attention to this ſubject, " my anxiety and care for theſe uſeful inſects; nor can " I communicate to you my experience, acquired during " a courſe of years."

We ſhall conclude this hiſtory of the Honey-bee with the following experiments for preventing a waſte of honey, and preſerving the lives of bees during the winter, communicated by a gentleman near the banks of the Tweed. " I have tried ſeveral experiments for preſer- " ving the lives of bees during the winter; and tho' " in general with little ſucceſs, yet I think I have reaſon " to continue, and adviſe others to follow, what I prac- " tiſed laſt winter. The method is very ſimple, and not " expenſive, for it is no other than keeping the bees in a " cold and dark place.

" My reaſon for trying this experiment, was my ha- " ving obſerved, that a certain degree of cold brought " upon the bees a ſtupor; and that the ſame degree of " cold continued, kept them in the ſame ſtate, till they " were brought into a warmer ſituation, which imme- " diately reſtored their life and vigour *.

" With this view I kept two hives ſhut up in a dark cold " out-houſe, from the middle of September to the middle " of April, without ever letting them ſee light: Upon " their being ſet out in the warmer air, they recovered im- " mediately, and ſhewed an appearance of more ſtrength " than the hives did which had been kept out in the u- " ſual way. This appearance of ſtrength continued du- " ring the ſummer, and they multiplied faſter than I had " ever obſerved them do before. They were rather " later in ſwarming this year than in former ſummers; " but the ſame was the caſe with many hives in this " neighbourhood: and even though this ſhould always " happen, yet I think other advantages will do more " than overbalance it. Could I go into the country ear- " ly in the ſpring, to look after the bees myſelf, I " would bring them into the open air ſome weeks ſooner, " carefully attend to the changes of the weather, and " ſhut up the doors of the hive on a bad day: but this " degree of care can ſcarcely be expected from ſervants " and gardeners, who have many other things to attend " to.

" I intend to have four hives put up this ſeaſon, in the " coldeſt dark place I can find; and as an ice-houſe is the " ſteadieſt and greateſt cold we have, one or two of my " friends who have ice-houſes, have promiſed to put a " hive upon the ice. By all accounts, the cold in Sibe- " ria does not kill the bees there; and in Ruſſia, where " the winters are extremely ſevere, bees produce much " honey: ſo I think there is not any danger to be " feared from any degree of cold we can expoſe the " bees to.

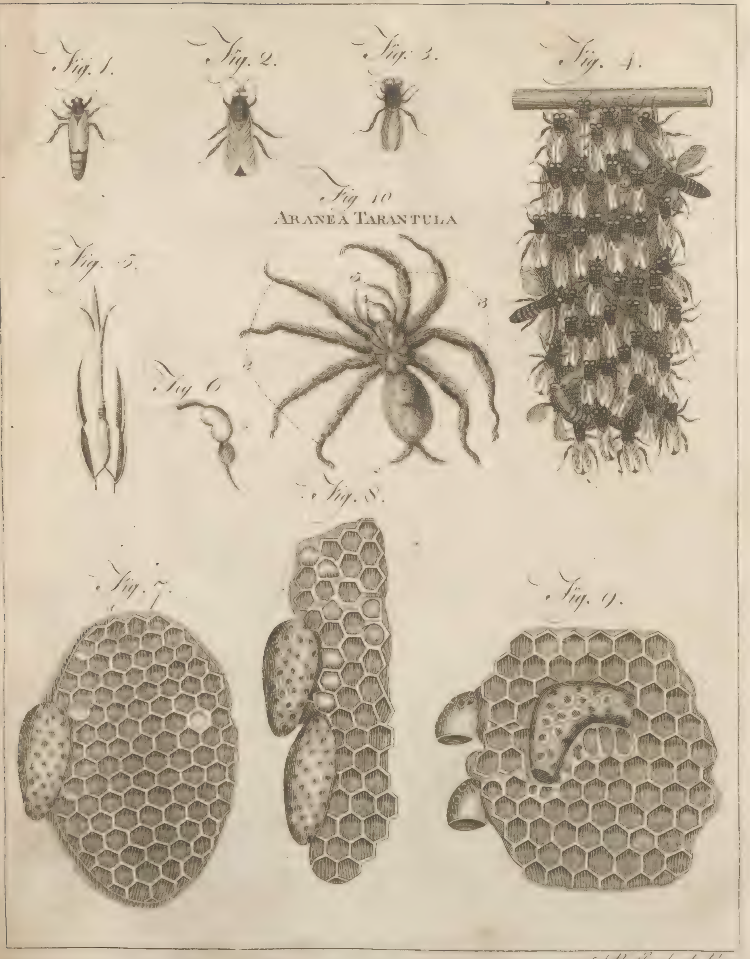
" If ſucceſs continues to attend this experiment of " keeping the bees aſleep all the winter and ſpring, with- " out conſuming their honey, a great point will be gain- " ed; eſpecially as Mr Wildman has taught us to take " the honey without killing the bees: for, by what I " have obſerved in this country, our bees are loſt chiefly " by being tempted to go out in a clear ſun in the ſpring, " though perhaps a froſty wind blows, and chills them, " ſo as to prevent their being able to return to the hive; " or an early warmth induces the queen to lay eggs, and " a number of young bees are bred, which conſume the " little proviſion left, before the fields can afford any " ſupply."

Explanation *of* Plate XXIII.

Figure 1. Is the queen bee. 2. Is the drone. 3. Is the working bee. 4. Repreſents the bees hanging to each other by the feet, which is the method of taking their repoſe. 5. The proboſcis or trunk, which is one of the principal organs of the bees, wherewith they gather the honey and take their nouriſhment. 6. One of the hind-legs of a working-bee, loaded with wax. 7. A comb, in which the working bees are bred. The cells are the ſmalleſt of any. Two of them have the young bees incloſed. A royal cell is ſuſpended on one ſide. 8. A comb in which the drones are bred, being larger than the former; the young drones being included in ſeveral of them; with two royal cells ſuſpended on the ſide. 9. A ſimilar comb, in which the royal cell is fixed in the middle of the comb; and ſeveral common cells are ſacrificed to ſerve as a baſis and

* This obſervation is confirmed by what Mr White ſays, *That bees which ſtand on the north-ſide of a building, whoſe height intercepts the ſun's beams all the winter, will waſte leſs of their proviſions, almoſt by half, than others which ſtand in the ſun; for, ſeldom coming forth, they eat little, and yet in the ſpring are as forward to work and ſwarm as thoſe which had twice as much honey in the autumn before.* See the Rev[d]. Mr White's method of preſerving bees. Third edition.

Plate. XXIII.



A. Bell Sculpt.

and support to it. In general, the royal cells are suspended on the side of a comb, as in fig. 7, 8. To the side of fig. 9. two royal cells are begun, when they resemble pretty much the cup in which an acorn lies. The other royal cells have the young queens included in them.

The 23d species is the apis cunicularia, or hairy bee, with an iron-coloured breast, and yellow belly. This species is very like the mellefica; they build their nests in dry sandy places. 24. The variegata; the breast and belly are variegated with white and black spots; the legs are of an iron colour. It is a native of Europe. This species sleep in the geranium phæum, or spotted crane's-bill. 25. The rostrata is distinguished by the upper lip being inflected, and of a conical shape, and by the belly being invested with bluish belts. They build their nests in high sandy grounds, and there is but one young in each nest. 26. The argillosa, or iron-coloured bee, has an inflected rostrum, and a crooked belly, with one joint. It is a native of Surinam. 27. The lagopoda is of a greyish colour, with an emarginated anus. 28. The manicata, or black bee, with hairy fore-legs; the belly is spotted with yellow; and the anus is tridentated. 29. The quatuor-dentata, is of a dusky colour, with five white belts on the belly, and the anus has four teeth-like protuberances; each intermediate tooth is forked. The last three species are natives of Europe. 30. The fasciata has a yellowish back, and a black belt round the edge of each wing; the breast is white; the belly is variegated with black and white; the legs are covered with black hair; and the feelers are green. It is a native of the Cape of Good Hope. 31. The barbara, or black bee, with a yellow edging round the breast, is about the size of an ant; the feelers are like threads. It is a native of Barbary. 32. The conica, or yellow bee, with an acute conical belly, and the margins of the joints or segments white; it dwells in cavities of the earth. 33. The annulata, or black bee, with a black front, and black rings round the legs. 34. The ruficornis has two iron-coloured spots on the breast and feelers; the belly is spotted with yellow. 35. The ferruginea, or smooth black bee, with the feelers, mouth, belly, and feet of an iron colour. This is a small bee, and supposed to be of an intermediate kind between the bee and wasp. The last three are natives of Europe. 36. The ichneumonea; the rostrum or snout is an erect horn; the belly is petiolated and black; and the breast is interspersed with shining gold-coloured sutures or indented lines; the antennæ are green. It is a native of America. 37. The cariosa is a yellowish hairy bee; and the feet and front are of a bright yellow colour. It builds in the rotten trees of Europe. 38. The violacea is a red bee, and very hairy, with bluish wings. It is a native of Europe. The violacea is said to perforate trees, and hollow them out in a longitudinal direction; they begin to build their cells at the bottom of these holes, and deposite an egg in each cell, which is composed of the farina of plants and honey, or a kind of gluten. 39. The caffra is also red, and covered with hair; the hind part of the breast and fore-part of the belly are yellowish. 40. The carolina is a red hairy bee, with the upper part of the belly yellow. It is a native of Carolina. 41. The terrestris is black and hairy, with a white belt round the breast, and a white anus. It builds its nest very deep in the earth. 42. The hortorum is a black hairy bee, with the fore part of the breast and belly yellow. 43. The pratorum, or black hairy bee, with the fore part of the breast yellow, and a blackish anus. 44. The lapidaria, or red hairy bee, with a yellow anus. It builds in holes of rocks. 45. The sylvarum, or pale hairy bee, with a black belt on the breast, and a reddish anus. 46. The muscorum, or yellow hairy bee, with a white belly. It builds in mossy grounds. 47. The hypnorum, or yellow hairy bee, with a black belt on the belly, and a white anus. 48. The lucorum, or yellow hairy bee, with a white anus. The last eight species are all natives of Europe. 49. The brasilianorum, or pale-red hairy bee, with the basis of the thighs black. This is a very large bee, every where covered with a testaceous skin. It is a native of America. 50. The acervorum is red and hairy, and builds below ground. 51. The subterranea is red and hairy, with a dusky anus; it likewise builds below ground. 52. The surinamensis is a black hairy bee, with the whole belly, excepting the first joint or segment, yellow. It is a native of Surinam. 53. The æstuans, or black hairy bee, with a yellow breast. 54. The tropica, or black hairy bee, with the hind part of the belly yellow. The two last are natives of the warm climates. 55. The alpina is a hairy bee, with a black breast, and yellow belly. It inhabits the mountains of Lapland.

APIUM, or PARSLEY, in botany, a genus of the pentandria digynia class. The fruit is of an oval shape and streaked; the involucrum consists of one leaf; and the petals are inflected. There are only two species of apium, *viz.* the petroselinum, a native of Sardinia; and the graveolens, a native of Britain. The seeds of the petroselinum are carminative, and the root is used as an aperient.

APIVORUS *Butea*, in ornithology, a synonime of a species of falco. See FALCO.

APLUDA, in botany, a genus of the polygamia monœcia class. The calix is a bivalved gluma; the flosculcs of the female are sessile, and the male flosculcs are furnished with pedunculi; the female has no calix; the corolla has a double valve; there is but one stylus, and one covered seed. The male has three stamina. There are three species of apluda, *viz.* the mutica, aristata, and zeugites, all natives of the Indies.

APOBATERION, in antiquity, a valedictory speech or poem made by a person on departing out of his own country, and addressed to his friends or relations.

APOCALYPSE, one of the sacred books of the New Testament, so called from its containing revelations concerning several important doctrines of Christianity.

APOCARPASUM, a poisonous drug, otherwise called *carpasum.*

APOCHYLISMA, in pharmacy, the same with ROB. See ROB.

APOCOPE, among grammarians, a figure which cuts off a letter or fyllable from the end of a word; as *ingení* for *ingenii*.

APOCRISIARIUS, in antiquity, an officer who delivered the meffages of the emperor. He became afterwards chancellor, and kept the feals. It was alfo a title given to a bifhop's refident at court, to the pope's deputy at Conftantinople, and to the treafurer of a monaftery.

APOCRUSTICS, in medicine, the fame with repellents. See REPELLENTS.

APOCRYPHAL, denotes fomething dubious, and is more particularly applied to fuch books as are not admitted into the canon of fcripture, being either not acknowledged as divine, or rejected as heretical and fpurious. The apocryphal books, according to the fixth article of the church of England, are to be read for example of life and inftruction of manners; but it doth not apply them to eftablifh any doctrine.

APOCYNUM, in botany, a genus of the pentandria digynia clafs. The corolla is campaniform, or fhaped like a bell. There are five fpecies, all natives of America.

APODICTICAL, among philofophers, a term importing a demonftrative proof, or fyftematical method of teaching.

APODOSIS, in rhetoric, the fame with axiofis. See AXIOSIS.

APODYTERIUM, in the ancient baths, the apartments where perfons dreffed and undreffed.

APOGEE, in aftronomy, that point of the orbit of a planet or the fun which is fartheft from the earth.

APOLLINARIAN *games*, in Roman antiquity, an appellation given to certain theatrical entertainments celebrated annually in honour of Apollo.

APOLLINARIANS, or APOLLINARISTS, in church-hiftory, a fect of heretics who maintained, that Jefus Chrift had neither a rational human foul, nor a true body.

APOLLINARIS, in botany. See HYOSCYAMUS.

APOLLONIA, in antiquity, an annual feftival celebrated by the Ægialians in honour of Apollo.

APOLLONIA, in geography, a promontory of Africa, upon the coaft of Guinea, near the mouth of the river Mancu.

APOLOGUE, in matters of literature, an ingenious method of conveying inftruction by means of a feigned relation called a moral fable.

The only difference between a parable and an apologue is, that the former being drawn from what paffes among mankind, requires probability in the narration; whereas the apologue, being taken from the fuppofed actions of brutes, or even of things inanimate, is not tied down to the ftrict rules of probability. Æfop's fables are a model of this kind of writing.

APOLOGY, a Greek term, literally importing an excufe, or defence of fome perfon or action.

APOMELI, among ancient phyficians, a decoction of honey and vinegar, much ufed as a detergent, promoter of ftool, urine, *&c.*

APONEUROSIS, among phyficians, a term fometimes ufed to denote the expanfion of a nerve or tendon in the manner of a membrane; fometimes for the cutting off a nerve; and, finally, for the tendon itfelf.

APONOGETON, in botany. See ZANNICHELLIA.

APOPHASIS, a figure in rhetoric, by which the orator, fpeaking ironically, feems to wave what he would plainly infinuate: as, *Neither will I mention thofe things, which if I fhould, you, notwithftanding, could neither confute nor fpeak againft them.*

APOPHLEGMATIZANTS, in pharmacy, medicines proper to clear the head from fuperfluous phlegm, whether by fpitting, or by the nofe.

APOPHTHEGM, a fhort, fententious, and inftructive remark, pronounced by a perfon of diftinguifhed character. Such are the apophthegms of Plutarch, and thofe of the ancients collected by Lycofthenes.

APOPHYGE, in architecture, a concave part or ring of a column, lying above or below the flat member. The French call it *le conge d'en bas*, or *d'en haut*; the Italians, *cavo di baffo*, or *di fopra*; and alfo, *il vivo di baffo*. The apophyge originally was no more than the ring or ferril, at firft fixed on the extremities of wooden pillars, to keep them from fplitting; which afterwards was imitated in ftone.

APOPHYSIS, in anatomy, a procefs or protuberance of a bone.

APOPLEXY, a diftemper in which the patient is fuddenly deprived of all his fenfes, and of voluntary motion. See MEDICINE, title, *Apoplexy*.

APORIA, is a figure in rhetoric, by which the fpeaker fhews, that he doubts where to begin for the multitude of matter, or what to fay in fome ftrange and ambiguous thing; and doth, as it were, argue the cafe with himfelf. Thus Cicero fays, *Whether he took them from his fellows more impudently, gave them to a harlot more lafcivioufly, removed them from the Roman people more wickedly, or altered them more prefumptuoufly, I cannot well declare.*

APOSIOPESIS, a form of fpeech, by which the fpeaker, through fome affection, as forrow, bafhfulnefs, fear, anger, or vehemency, breaks off his fpeech before it be all ended. A figure, when fpeaking of a thing, we yet feem to conceal it, though indeed we aggravate it; or when the courfe of the fentence begun is fo ftayed, as thereby fome part of the fentence, not being uttered, may be underftood; as, *I might fay much more, but modefty commands filence.*

APOSTACY, the abandoning the true religion. The primitive Chriftian church diftinguifhed feveral kinds of apoftacy. The firft, of thofe who went over entirely from Chriftianity to Judaifm; the fecond, of thofe who mingled Judaifm and Chriftianity together; and the third, of thofe who complied fo far with the Jews as to communicate with them in many of their unlawful practices, without making a formal profeffion of their religion. But the fourth fort was of thofe who, after having been fometimes Chriftians, voluntarily relapfed into Paganifm.

APOSTASIS, in medicine, the fame with abfcefs. See ABSCESS.

APOSTATE, one who deferts his religion. Among the

the Romaniſts, it ſignifies a man who, without a legal diſpenſation, forſakes a religious order of which he had made profeſſion. Hence,

APOSTATA *capiendo*, in the Engliſh law, a writ that formerly lay againſt a perſon, who having entered into ſome order of religion, broke out again, and wandered up and down the country.

A POSTERIORI, or demonſtration *à poſteriori*. See DEMONSTRATION.

APOSTHUME, or APOSTEM, the ſame with abſceſs. See ABSCESS.

APOSTIL, in matters of literature, the ſame with a marginal note.

APOSTLE properly ſignifies a meſſenger or perſon ſent by another upon ſome buſineſs; and hence, by way of eminence, denotes one of the twelve diſciples commiſſioned by Jeſus Chriſt to preach the goſpel.

The apoſtles are uſually repreſented with their reſpective badges: Thus Peter is painted with the keys; Paul, with a ſword; Andrew, with a croſs; James the greater, with a pilgrim's ſtaff; James the leſs, with a fuller's pole; John, with a cup and winged ſerpent flying out of it; Bartholomew, with a knife; Philip, with a long ſtaff, the upper end of which is formed into a croſs; Thomas, with a lance; Matthew, with a hatchet; Matthias, with a battle-axe; Simon, with a ſaw; and Jude, with a club.

APOSTLES *creed*. See CREED.

APOSTLES *ointment*. See OINTMENT.

APOSTOLICI, an early ſect of Chriſtians, who pretended to lead their lives in imitation of the apoſtles. They condemned marriage.

APOSTROPHE, in rhetoric, a figure by which the orator, in a vehement commotion, turns himſelf on all ſides, and applies to the living and dead, to angels and to men, to rocks, groves, *&c.* Thus Adam, in Milton's Paradiſe Loſt,

> *O woods, O fountains, hillocks, dales, and bowers,*
> *With other echo,* &c.

APOSTROPHE, in grammar, the contraction of a word by the uſe of a comma; as *call'd* for *called*, *tho'* for *though*.

APOTACTITES, in church-hiſtory, a name given to the Apoſtolici, from the ſhew they made of renouncing the world more than other men. See APOSTOLICI.

APOTHECARY, one who practiſes the art of pharmacy.

APOTHEOSIS, in antiquity, a ceremony by which the ancient Romans complimented their emperors and great men, after their death, with a place among the gods. It is deſcribed as follows. After the body of the deceaſed had been burnt with the uſual ſolemnities, an image of wax, exactly reſembling him, was placed on an ivory couch, where it lay for ſeven days, attended by the ſenate and ladies of the higheſt quality in mourning; and then the young ſenators and knights bore the bed of ſtate through the via ſacra to the old forum, and from thence to the campus martius, where it was depoſited upon an edifice built in form of a pyramid. The bed being thus placed amidſt a quantity of ſpices and other combuſtibles, and the knights having made a ſolemn proceſſion round the pile, the new emperor, with a torch in his hand, ſet fire to it, whilſt an eagle, let fly from the top of the building, and mounting in the air with a firebrand, was ſuppoſed to convey the ſoul of the deceaſed to heaven; and thenceforward he was ranked among the gods.

APOTOME, in geometry, the difference between two incommenſurable lines.

APOTOME, in muſic, the difference between a greater and leſſer ſemi-tone, expreſſed by the ratio 128 : 125.

APOZEM, in medicine, the ſame with decoction. See DECOCTION.

APPARATUS, a term uſed to denote a complete ſet of inſtruments, or other utenſils, belonging to any artiſt or machine: thus we ſay a ſurgeon's apparatus.

APPARENT, in a general ſenſe, ſomething that is viſible to the eyes, or obvious to the underſtanding.

APPARENT, among mathematicians and aſtronomers, denotes things as they appear to us, in contradiſtinction from real or true: thus we ſay, the apparent diameter, diſtance, magnitude, place, figure, *&c.* of bodies.

APPARENT *heir*, in Scots law, the perſon entitled to ſucceed to the eſtate of a defunct, before he is actually entered. See SCOTS LAW, title, *Succeſſion in heritable rights*.

APPARITION, in a general ſenſe, denotes ſimply the appearance of a thing. In a more limited ſenſe, it is uſed for a ſpectre or ghoſt.

APPARITOR, among the Romans, a general term to comprehend all attendants of judges and magiſtrates appointed to receive and execute their orders. Apparitor, in England, is a meſſenger that ſerves the proceſs of a ſpiritual court, or a beadle in an univerſity who carries the mace.

APPARURA, among old law-writers, ſignifies furniture or tackle, particularly that belonging to a plough.

APPAUMEE, in heraldry, denotes one hand extended with the full palm appearing, and the thumb and fingers at full length.

APPEAL, in law, the removal of a cauſe from an inferior to a ſuperior court or judge, when a perſon thinks himſelf aggrieved by the ſentence of the inferior judge. Appeals lie from all the ordinary courts of juſtice to the Houſe of Lords. In eccleſiaſtical cauſes, if an appeal is brought before a biſhop, it may be removed to the archbiſhop; if before an archdeacon, to the court of arches, and thence to the archbiſhop; and from the archbiſhop's court, to the king in chancery.

APPEAL *of maim*, is the accuſing one that has maimed another.

APPEARANCE, in a general ſenſe, the exterior ſurface of a thing, or that which immediately ſtrikes the ſenſes.

APPEARANCE, in law, ſignifies a defendant's filing a common or ſpecial bail, on any proceſs iſſued out of a court of judicature.

APPELLANT, in a general ſenſe, one who appeals. See APPEAL.

APPELLANTS, in church-hiſtory, an appellation given to ſuch of the catholic clergy, as appeal from the conſtitution unigenitus, to a general council.

APPELLATIVE. Words and names are either common or proper. Common names are ſuch as ſtand for univerſal ideas, or a whole rank of beings, whether ge-

neral

neral or special. These are called *appellatives*. So fish, bird, man, city, river, are common names; and so are trout, eel, lobster; for they all agree to many individuals, and some to many species.

APPELLEE, among lawyers, the person against whom an appeal is brought. See APPEAL.

APPENDIX, in literature, a treatise added at the end of a work, to render it more complete.

APPERCEPTION, or ADPERCEPTION, a term used by Leibnitz and his followers for consciousness.

APPERTINANCES, the same with appurtenances. See APPURTENANCES.

APPETITE, in a general sense, the desire of enjoying some object supposed to be conducive to our happiness.

APPETITE, in medicine, a certain painful or uneasy sensation, always accompanied with a desire to eat or drink.

APPLAUSE, an approbation of something, signified by clapping the hands, still practised in theatres.

APPLE, the fruit of the pyrus malus, or apple-tree. See PYRUS.

APPLE *of the eye*, a name not unfrequently given to the pupil. See p. 289.

APPLEBY, the chief town of the county of Westmoreland, situated on the river Eden, in 2° 26′ W. long. and 54° 30′ N. lat. It sends two members to parliament.

APPLICATE, or ORDINATE *applicate*, in geometry. See ORDINATE.

APPLICATION, in a general sense, is the laying two things together, in order to discover their agreement or disagreement.

APPLICATION, in geometry, is used either for division, for applying one quantity to another, whose arreas, but not figures, shall be the same; or, for transferring a given line into a circle, or other figure, so that its ends shall be in the perimeter of the figure.

APPLICATION, among divines, a term used to signify the same as imputation. See IMPUTATION.

APPOGIATURA, in music, a small note inserted by the practical musician, between two others, at some distance.

APPOINTE'E, a foot-soldier, or officer in the French army, who receives a greater pay than others of the same rank, in consideration of his valour or long service.

APPOINTE'E, in heraldry, the same as aguisée: Thus we say, a cross appointée, to signify that which two angles at the end cut off, so as to terminate in points.

APPOINTMENT, in a general sense, the same as assignation. See ASSIGNATION. In a more restrained sense, it signifies a pension given by princes and noblemen to retain certain persons in their service.

APPORTIONMENT, in law, the division of a rent into parts, in the same manner as the land out of which it issues is divided.

APPOSITION, in grammar, the placing two or more substantives together in the same case, without any copulative conjunction between them; as, *Ardebat Alexim delicias domini*.

APPRAISING. See APPRYSING.

APPREHENSION, in logic, the first or most simple act of the mind, whereby it perceives, or is conscious of some idea. See PERCEPTION, and LOGIC.

APPRYSING, in Scots law, the name of that action by which a creditor formerly carried off the estate of his debtor for payment. It is now abolished, and adjudications are appointed in place of it. See SCOTS LAW, title, *Apprysings and Adjudications*.

APPROACH, or APPROACHING, in a general sense, the acceding or coming together of two or more things.

APPROACHES, in fortification, the works thrown up by the besiegers, in order to get nearer a fortress, without being exposed to the enemies cannon.

APPROACHING, in gardening, the inoculating or ingrafting the sprig of one tree into another, without cutting it off from the parent-tree.

APPROACHING, in fowling, a method of getting nearer the birds by means of a machine, made of hoops and boughs of trees, within which the sportsman conceals himself.

APPROPRIARE *communiam*, in law, is to discommon, that is, to inclose any parcel of land that before was open and common.

APPROPRIARE *ad honorem*, to bring a manor within the liberty of an honour. See MANOR, and HONOUR.

APPROPRIATION, in law, a severing of a benefice ecclesiastical to the proper and perpetual use of some religious house, or dean and chapter, bishoprick, or college; because, as persons ordinarily have no right of fee simple, these, by reason of their perpetuity, are accounted owners of the fee simple; and therefore are called *proprietors*. To an appropriation, after the licence obtained of the king in chancery, the consent of the diocesan, patron, and incumbent, are necessary, if the church be full; but, if the church be void, the diocesan and the patron, upon the king's licence, may conclude.

APPROXIMATION, in arithmetic and algebra, the coming nearer and nearer to a root, or other quantity sought, without expecting to be ever able to find it exactly.

APPUI, in the menage, the sense of the action of the bridle in the horseman's hand. Thus we say, a horse has no *appui*, when he cannot suffer the bit to bear never so little upon the parts of the mouth. To give a horse a good appui, he should be galloped, and put often back.

APPULSE, in astronomy, the approach of a planet towards a conjunction with the sun or any of the fixed stars.

APRICOT, in botany, the English name of the prunus Armeniaca. See PRUNUS.

APRIL, in chronology, the fourth month of the year, containing only 30 days.

A PRIORI, a kind of demonstration. See DEMONSTRATION.

APRON, in gunnery, the piece of lead which covers the touch-hole of a cannon. See CANNON.

APSIS, in astronomy, a term used indifferently for either of the two points of a planet's orbit, where it is at the greatest or least distance from the sun or earth. Hence

Hence the line connecting these points is called the *line of the apsides*. See ASTRONOMY.

APSIS, among ecclesiastical writers, denotes the inner part of the ancient churches, answering to the modern choir. It is also used for the bishop's throne, and sometimes for the ambo. See AMBO.

APSYRTUS, in botany. See MARRUBIUM.

APTE, a small city of Provence, in France, situated about 25 miles north of Aix, in 5° 20′ E. long. and 43° 50′ N. lat.

APTERA, the term used by Linnæus for his seventh order of insects, comprehending such as have no wings.

APTHANE, a title anciently given to the highest degrees of nobility in Scotland. See THANE.

APTOTE, among grammarians, an indeclinable noun, or one which has no variation of cases.

APUA, in ichthyology, an obsolete name of the gobius. See GOBIUS.

APULIA, or PUGLIA, in geography. See PUGLIA.

APUS, in ornithology, the trivial name of a species of hirundo. See HIRUNDO.

APYCNI *Suoni*, in music, sounds distant one or more octaves, and yet concord.

APYCNOS, in music, is said of the diatonic genus, on account of its having spacious intervals, in comparison of the chromatic and enharmonic. See DIATONIC, CHROMATIC, *&c.*

APYREXY, among physicians, denotes the intermission of a fever.

AQUA, a term frequently met with in the writings of physicians, chemists, *&c.* for certain medicines, or menstruums, in a liquid form, distinguished from each other by peculiar epithets; as,

AQUA *alexiteria*, a water distilled from mint, sea-wormwood, and angelica; and said to be good in malignant and pestilential cases.

AQUA *aluminosa*, alum-water, a solution of water and white vitriol; esteemed good in ulcers and cutaneous eruptions.

AQUA *fortis*, a corrosive liquor, made by distilling purified nitre with calcined vitriol, or rectified oil of vitriol, in a strong heat; the liquor, which rises in fumes red as blood, being collected, is the spirit of nitre or aqua fortis; which serves as a menstruum for dissolving of silver, and all other metals, except gold. But if sea-salt, or sal ammoniac be added to aqua fortis, it commences *aqua regia*. Aqua fortis is commonly held to have been invented about the year 1300; though others will have it to have been known in the time of Moses. It is serviceable to refiners, in separating silver from gold and copper; to the workers in mosaic, for staining and colouring their woods; to dyers, in their colours, particularly scarlet; and to other artists, for colouring bone and ivory. With aqua fortis bookbinders marble the covers of books, and diamond-cutters separate diamonds from metalline powders. It is also used in etching copper or brass plates. See CHEMISTRY, *Of the nitrous acid.*

AQUA *marina*, a name by which the jewellers call the beryl, on account of its sea-green colour. See BERYL.

AQUA *mercurialis*, a solution of sublimate of mercury, and a little mercury, in aqua regia.

AQUA *mirabilis*, the wonderful water, is prepared of cloves, galangals, cubebs, mace, cardomums, nutmegs, ginger, and spirit of wine, digested 24 hours, then distilled. It is a good and agreeable cordial.

AQUA *omnium florum*, in pharmacy, the water distilled from the dung of cows, when they go to grass; in English, *All-flower-water*.

AQUA *regia*, an acid corrosive spirit, so called, because it serves as a menstruum to dissolve gold, commonly esteemed the king of metals. Its basis, or essential ingredient, is common sea-salt, the only salt in nature which will operate on gold. It is commonly prepared by mixing common sea-salt, or sal ammoniac, or the spirit of them, with spirit of nitre, or common aqua fortis. See CHEMISTRY, title, *Of aqua regia.*

AQUA *secunda*, denotes aqua fortis, which has been used to dissolve some metal.

AQUA *sulphurata*, the same with gas sulphuris. See GAS.

AQUA *vitæ*, the water of life, a name given to malt spirits in contradistinction from brandy.

AQUA *vitriolica cærulea*, a solution of blue vitriol and alum, with some spirit of vitriol, in water; recommended in inflammatory and putrid cases.

AQUÆ *pavor*, in medicine. See HYDROPHOBIA.

AQUÆDUCT, in hydraulics and architecture, a conveyance made for carrying water from one place to another. Those of the ancient Romans were surprisingly magnificent. That which Lewis XIV. built near Maintenon, for carrying the Bucq to Versailles, is perhaps the greatest now in the world: It is seven thousand fathoms long, with two thousand five hundred and sixty fathoms of elevation, and contains two hundred and forty-two arcades.

AQUA-NEGRA, a small town of the Mantuan, in Italy, situated upon the Chiese, in 9° E. long. and 45° 10′ N. lat.

AQUAPENDENTE, a city of the ecclesiastical state, in Italy, situated upon the river Paglia, abounding in waters.

AQUARIANS, in church-history, an ancient sect of heretics, who, under pretence of abstinence, made use of water instead of wine in the eucharist.

AQUARIUS, in astronomy, a constellation which makes the eleventh sign in the zodiac, marked thus ♒. See ASTRONOMY.

AQUARTIA, in botany, a genus of the tetrandria monogynia class. There is only one species, called aculeata, a native of Europe.

AQUATIC, in natural history, an appellation given to such things as live or grow in the water.

AQUAVIVA, a town of the kingdom of Naples, and province of Barri.

AQUEDUCT. See AQUÆDUCT.

AQUELEIA, a patriarchal city of Italy, near the end of the gulph of Venice, situated in 13° 30′ E. long. and 46° 20′ N. lat.

AQUEOUS, in a general sense, something partaking of the nature of water, or that abounds with it.

AQUEOUS *humour*, in anatomy. See p. 289.

AQUIFOLIUM, in botany, the trivial name of a ſpecies of ilex. See ILEX.

AQUILA, in ornithology, a ſynonime of the falco, or eagle. See FALCO.

AQUILA, in aſtronomy, a conſtellation of the northern hemiſphere. See ASTRONOMY.

AQUILA, in geography, a large city of Abruzzo, in the kingdom of Naples, ſituated in 14° 20′ E. long. and 42° 40′ N. lat.

AQUILEGIA, or COLUMBINE, in botany, a genus of the polyandria pentagynia claſs. It has no calix; the petals are five, and five horn-like nectaria are inſerted betwixt each petal; it has alſo five ſeparate capſules. There are three ſpecies of aquilegia, *viz.* the vulgaris, or common columbine, a native of Britain; the alpina, a native of Switzerland; and the Canadenſis, a native of Virginia and Canada. The aquilegia is reckoned to be an aperient, but has long ſince given way to more powerful medicines.

AQUILICIUM, or AQUILICIANA, in Roman antiquity, ſacrifices performed in times of exceſſive drought, to obtain rain of the gods.

AQUILINE, ſomething belonging to, or reſembling an eagle: Thus, an aquiline noſe is one bent ſomewhat like an eagle's beak.

AQUINO, a ruinous city in the province of Lavoro, in the kingdom of Naples, ſituated in 14° 30′ E. long. and 41° 30′ N. lat.

ARA, in aſtronomy, a ſouthern conſtellation, containing eight ſtars.

ARABET, a town of Turkiſh Tartary, ſituated near the Palus Mœotis. It is fortified with two caſtles; and is the place where the khan keeps his ſtud of horſes, which are reckoned to be about ſeven thouſand in number.

ARABIA, a large country of Aſia, having Turky on the north, Perſia and the gulf of Perſia on the eaſt, the Indian ocean on the ſouth, and the Red ſea and iſthmus of Suez on the weſt; and ſituated between 35° and 60° E. long. and between 12° and 30° N. lat.

Arabia, though ſubject to a great many different princes, is only conſidered by geographers as ſubdivided into the three grand diviſions of Arabia Felix, Arabia Deſerta, and Arabia Petrea.

ARABIAN, or ARABIC, in a general ſenſe, ſomething belonging to Arabia: Thus we ſay, Arabian characters, Arabian language, *&c.* See HEBREW.

Gum ARABIC, the name of a gum which diſtills from the Egyptian acacia tree. It is brought to us from Turky, in ſmall irregular maſſes or ſtrings of a pale yellow colour. The true gum-arabic is rarely to be met with in the ſhops, gum-ſenega being uſually ſold in place of it: This reſembles the other, but is generally in large rough pieces. The true kind is preferred as a medicine; but the other is cheapeſt and ſtrongeſt, and therefore preferred for mechanical uſes. It is given, from a ſcruple to two drams, in hoarſeneſs, a thin acrimonious ſtate of the juices, and where the natural mucus of the inteſtines is abraded. It is likewiſe an ingredient in the white decoction, chalk julep, and other compoſitions.

ARABICI, a ſect of heretics, who held, that the ſoul both dies and riſes again with the body.

ARABIS, in botany, a genus of the tetradynamia ſiliquoſa claſs. The generic mark is taken from four nectariferous glands which lie on the inſide of each leaf of the calix. There are eight ſpecies of arabis, none of which are natives of Britain, except the thaliana, or coded mouſe-ear.

ARABISM, in language, an idiom peculiar to the Arabian language.

ARABLE *lands*, thoſe which are fit for tillage, or which have been formerly tilled.

ARACK, ARRACK, or RACK, a ſpirituous liquor imported from the E. Indies, uſed by way of dram and in punch. The word *arack* is an Indian name for ſtrong waters of all kinds; for they call our ſpirits and brandy *Engliſh arack*. But what we underſtand by the name arack, is really no other than a ſpirit procured by diſtillation from a vegetable juice called *toddy*, which flows by inciſion out of the cocoa-nut tree. There are divers kinds of it; ſingle, double, and treble diſtilled. The double diſtilled is commonly ſent abroad, and is preferred to all other aracks of India.

ARACAN, the capital city of a ſmall kingdom, ſituated on the north-eaſt part of the gulf of Bengal, in 93° E. long. and 20° 30′ N. lat.

ARACARI, in ornithology, the trivial name of a ſpecies of ramphaſtos. See RAMPHASTOS.

ARACH, the chief city of Arabia Petrea, ſituated in 49° E. long. and 30° 20′ N. lat.

ARACHIS, in botany, a genus of the diadelphia decandria claſs. There is only one ſpecies, *viz.* the hypogæa, a native of America. The calix is divided into two parts; and the capſule or pod is cylindrical, and contains two ſeeds.

ARACHNOIDES, in anatomy, an appellation given to ſeveral membranes, as the tunic of the cryſtalline humour of the eye, the external lamina of the pia mater, and one of the coverings of the ſpinal marrow.

ARÆOMETER, an inſtrument to meaſure the gravity of liquors, which is uſually made of a thin glaſs ball, with a taper neck, ſealed at the top, there being firſt as much mercury put into it as will keep it ſwimming in an exact poſture. The neck is divided into two parts, which are numbered, that ſo by the depths of its deſcent into any liquor, its lightneſs may be known by theſe diviſions.

ARÆOSTYLE, in architecture, a term uſed by Vitruvius, to ſignify the greateſt interval which can be made between columns.

ARÆOTICS, in medicine, remedies which rarefy the humours, and render them eaſy to be carried off by the pores of the ſkin.

ARAF, among the Mahometans. See ALARAF.

ARAFAT, a mountain of Arabia, near Mecca, where the Mahometans believe that Abraham offered to ſacrifice Iſhmael.

ARAGON, a province of Spain, having Biſcay and the Pyrenean mountains on the north, Catalonia on the

the east, Valencia on the south, and the two Castiles on the west.

ARAIGNEE, in fortification, signifies the branch, return, or gallery of a mine. See MINE.

ARALIA, in botany, a genus of the pentandria pentagynia class. The involucrum is an umbella; the calix has five teeth, and is above the fruit; the corolla has five petals; and the berry has five seeds. There are five species of aralia, all natives of the Indies.

ARALIASTRUM, in botany. See PANAX.

ARANDA *de Duero*, a city of Old Castile, in Spain, situated on the Duero, between Osma and Valladolid; so called, to distinguish it from another city of the same name, situated upon the Ebro.

ARANEA, the SPIDER, a genus of insects belonging to the order of aptera, or insects without wings. All the species of spiders have eight legs, with three joints in each, and terminating in three crooked claws; eight eyes, two before, two behind, and the rest on the sides of the head. The mouth consists of two claws or talons, denticulated like a saw. A little below the point of the claw, there is a small hole, through which the spider emits a kind of poison. These claws are the weapons with which they kill flies, *&c.* for their food. The belly or hinder part is separated from the head and breast by a small thread-like tube. The skin or outer surface is a hard polished crust. Spiders have five tubercles or nipples at the extremity of the belly, whose apertures they can enlarge or contract at pleasure. It is through these apertures that they spin a gluey substance with which their bellies are full. They fix the end of their threads by applying these nipples to any substance, and the threads lengthen in proportion as the animal recedes from it. They can stop the issuing of the threads by contracting the nipples, and re-ascend by means of the claws on their feet, much in the same manner as some men warp up a rope. When the common house-spider begins her web, she generally chuses a place where there is a cavity, such as the corner of a room, that she may have a free passage on each side, to make her escape in case of danger. Then she fixes one end of her thread to the wall, and passes on to the other side, dragging the thread along with her, (or rather the thread follows her as she proceeds), till she arrives at the other side, and there fixes the other end of it. Thus she passes and repasses, till she has made as many parallel threads as she thinks necessary for her purpose. After this, she begins again and crosses these by other parallel threads, which may be named the *woof*. These are the toils or snares which she prepares for entangling flies, and other small insects, which happen to light upon it. But, besides this large web, she generally weaves a small cell for herself, where she lies concealed watching for her prey. Betwixt this cell and the large web, she has a bridge of threads, which, by communicating with the threads of the large one, both give her early intelligence when any thing touches the web, and enables her to pass quickly in order to lay hold of it. There are many other methods of weaving peculiar to different species of spiders. But, as they are all intended for the same purpose, it is needless to give particular descriptions of them.

Linnæus enumerates 47 species of spiders, *viz.* 1. The diadema, has a globular reddish belly, with a white cross. It inhabits the birch-tree. 2. The reticulata, has a reticulated round belly, and is dusky or purple on the back. It frequents gardens. 3. The cucurbitina, has a globular yellow belly, with a few black spots. It lives in the leaves of trees, and incloses its eggs in a soft net. 4. The calycina, with a round pale yellow belly, and two hollow points. It lives in the cups of flowers, after the flower-leaves have fallen off, and catches bees, and other flies, when they are in search of honey. 5. The octopunctata, with a roundish yellow belly, four black marks on each side, and a red anus. It is a native of Sweden. 6. The bipunctata, with a round red belly, and two hollow points. It frequents windows. 7. The arundinacia, with a white roundish belly, and dusky-coloured spots. It frequents reeds. 8. The angulata, with an oval belly; the fore-part of the sides form an acute angle. It frequents trees. 9. The domestica, or common house-spider, has a dusky oval belly, with five contiguous black spots. 10. The trilineata, with a white belly, and three longitudinal lines of blackish spots. It lives in woods. 11. The riparia, has an oval glazed black belly, and a yellowish forked hairy anus. It lives in the sandy banks of rivers. 12. The labyrinthica, with a dusky oval belly, a whitish indented line, and a forked anus. The web of this species is horizontal, with a cylindrical well or tube in the middle. 13. The quadrilineata, has a roundish yellow belly, and four spots and four purple lines on each side. It is a native of Sweden. 14. The redimita, has an oblong yellow belly, and a red oval ring on the back. It frequents gardens. 15. The corollata, has a black oval belly, and an oval white ring on the back. It dwells upon plants. 16. The fumigata, has a dusky oval belly, and two white points at the base. It lives in the fields. 17. The montana, has a white oval belly, with ash-coloured spots. It lives in trees. 18. The sanguinolenta, has a blood-coloured belly, with a black longitudinal line. It is a native of Spain. 19. The notata, has an oval dusky-coloured belly, with white transverse lines. 20. The rufipes, has a dusky belly, and reddish legs. It most frequently lives among nettles. 21. The nocturna, has a black belly, with two white points, and a little white half-moon at the base of the anus. 22. The extensa, has a long greenish shining belly, and its legs are extended longitudinally. It frequents marshy grounds. 23. The fimbriata, has a black oblong belly, with a white line on each side, and dusky-coloured legs. It lives in water, upon the surface of which it runs with great swiftness. 24. The sexpunctata, has an oblong belly, and three pair of hollow points. It lives in woods. 25. The flavissima, has a smooth oblong belly of a very yellow colour. It is a native of Egypt. 26. The bimaculata, has a chesnut-coloured roundish belly, with two white points. 27. The clavipes, has an oblong belly, and the last joints of the legs, excepting the third pair, are hairy and clavated. It is a native of America. 28. The quadripunctata, has a black oblong belly, and four hollow

low points. It is to be met with in windows, *&c.* 29. The holosericea, has an ovallish belly covered with a down like velvet; at the base, or under part, it has two yellow spots. It is found in the folded leaves of plants. 30. The senoculata, is distinguished from the rest by having only six eyes. 31. The avicularia, has a convex round breast, hollowed transversely in the middle. It is a native of America, and feeds upon small birds, insects, *&c.* The bite of this spider is as venomous as that of the serpent. 32. The spinimobilis, has moveable black spines on its legs. It is a native of Surinam. 33. The venatoria, is a hairy spider, with a round convex breast, about the same size with the belly, which is oval. It is a native of America. 34. The ocellata, has three pair of eyes on its thighs. It is about the same size with the tarantula, of a pale colour, with a black ring round the belly, and two large black spots on the sides of the breast. It is a native of China. 35. The tarantula, Plate XXIII. fig. 10. The breast (1), and belly (2), are of an ash-colour; the legs (3) are likewise ash-coloured, with blackish rings on the under part; the fangs, or nippers (4), are red on the inner side, the rest being blackish; (5) is the antennæ or feelers: Two of its eyes are larger than the other, red, and placed in the front; four other eyes are placed in a transverse direction towards the mouth; the other two are nearer the back. It is a native of Italy, Cyprus, Barbary, and the E. Indies. The breast and belly are about two inches long, terminated by two short tails. This figure was taken from the life, in the island of Cyprus, by Alex[r] Drummond, Esq; late consul at Aleppo. The bite of the tarantula is said to occasion an inflammation in the part, which in a few hours brings on sickness, fainting, and difficulty of breathing: The person afterwards is affected with a delirium, putting himself into the most extravagant postures. However, this is not always the case; for they are sometimes seized with a deep melancholy. The same symptoms return annually, in some cases, for several years, and at last terminate in death. Music is said to be the only cure. It induces the patient to dance, and sweat out the poison. 36. The scenica, is a black jumping spider, with three white semicircular lines across its body. It frequents old walls. 37. The truncorum, is a black jumping spider, with white spots on the back. It frequents walls, and old wood. 38. The rupestris, is a jumping spider, with black spots on its belly, which is edged with red and white in the middle. It frequents walls and trees. 39. The aquatica, is of a livid colour, with an oval belly, and a transverse line, and two hollowed points. It frequents the fresh waters of Europe; and lodges, during the winter, in empty shells, which it dextrously shuts up with a web. 40. The saccata, has an oval belly of a dusky iron colour. It lives in the ground, and carries a sack with its eggs, where-ever it goes. This sack it glues to its belly, and will rather die than leave it behind. 41. The palustris, has an oblong cloudy belly, with two white lines on each side. It frequents marshy grounds. 42. The virescens has an oblong greenish yellow belly, with white lines on the sides. It frequents gardens. 43. The viatica, has a roundish plain belly, with the four last legs shorter than the others. It frequents gardens, and sits upon its eggs. 44. The lævipes, has a depressed rhomboidal belly, with its legs extended in a transverse direction. It is found on trees and walls. 45. The tetracantha, has a lunated belly, and is found in St Thomas's isle. 46. The cancriformis, has a globular belly, and is a native of America. 47. The spinosa, has eight spines on its back, and a conical belly. It is a native of America.

ARANEA *conchea*, the spider-shell, a name given to several species of murex. See MUREX.

ARANEUS, in zoology, the trivial name of a species of cancer. See CANCER.

ARANJUEZ, a palace belonging to the king of Spain, beautifully situated on the banks of the Tagus, about fifteen or sixteen miles eastward of Madrid.

ARAPABACA, in botany, a synonime of the spigelia. See SPIGELIA.

ARARAT, the name anciently given to part of mount Caucasus, lying between the Euxine and Caspian seas, and where Noah's ark rested.

ARARAUNA, in ornithology, the trivial name of a species of psittacus. See PSITTACUS.

ARASH, a city of the province of Afgar, in the kingdom of Fez, where the river Luca falls into the Western Ocean.

ARAUCO, a city of Chili, in S. America, situated on a river of the same name, in 78° W. long. and 37° S. lat.

ARAXES, or ARRAS, a river of Persia. See ARRAS.

ARAYA, one of the most celebrated capes in S. America, forming the north point of the river Oronoque. See ORONOQUE.

ARBALET, the same with cross-bow. See CROSS-BOW.

ARBELA, or IRBIL, in geography. See IRBIL.

ARBITER, in law, a person to whose decision any dispute or difference is voluntarily referred by the parties.

ARBITRARY, that which is left to the choice or arbitration of men, or not fixed by any positive law or injunction.

ARBITRARY *punishment*, in Scots law, denotes such punishments as are by statute left to the discretion of the judge. It is a general rule in arbitrary punishments, that the judge cannot inflict death. Hence all punishments that are not capital have acquired the name of arbitrary punishments, even although they be expressly pointed out by statute.

ARBITRATION, ARBITRAGE, or ARBITREMENT, the power given by contending parties to an arbiter. See ARBITER.

ARBITRATOR, a private extraordinary judge, chosen by the mutual consent of parties, to determine controversies between them.

ARBOIS, a town of Franch Compte in France, situated in 5° 40′ E. long. and 46° 50′ N. lat.

ARBON, a town of Swabia in Germany, situated in 9° 30′ E. long. and 47° 40′ N. lat.

ARBOR, in mechanics, the principal part of a machine which serves to sustain the rest: also the axis or spindle on which a machine turns, as the arbor of a crane, windmill, *&c.*

ARBO-

ARBORIST, a perſon ſkilled in that part of botany which treats of trees.

ARBOUR, in gardening, a kind of ſhady bower, formerly in great eſteem, but of late rejected, on account of its being damp and unwholeſome.

Arbours are generally made of lattice-work, either of wood or iron, and covered with elms, limes, hornbeams; or with creepers, as honey-ſuckles, jaſmines, or paſſion-flowers; either of which will anſwer the purpoſe very well, if rightly managed.

ARBUTUS, in botany, a genus of the decandria monogynia claſs. The calix of the arbutus is divided into five parts; the corolla is ovated; the fruit is a berry with five partitions or cells. There are five ſpecies of arbutus, *viz.* the unedo, or common ſtrawberry-tree, a native of Britain; the andrachne, a native of the Eaſt Indies; the acadienſis, a native of Acadia; the alpina, or mountain ſtrawberry-tree, a native of Britain; and the uva urſi, a plant lately diſcovered in the Highlands of Scotland, and which formerly was thought not to be a native of Britain.

ARC, ARK, or ARCH. See ARCH.

ARCA *cordis*, the ſame with pericardium. See PERICARDIUM.

ARCADIA, a ſea-port town of European Turky, ſituated on the weſtern coaſt of the Morca, in 22° E. long. and 37° 20′ N. lat.

ARCANGIS, in the Turkiſh armies, a kind of irregular light-armed horſe which ſubſiſt by plunder.

ARCANUM, among phyſicians, any remedy, the preparation of which is induſtriouſly concealed, in order to enhance its value.

ARCBOUTANT, in building, an arched buttreſs. See BUTTRESS.

ARCH, in geometry, any part of the circumference of a circle or curved line, lying from one point to another, by which the quantity of the whole circle or line, or ſome other thing ſought after, may be gathered. See GEOMETRY.

ARCH, in architecture, a concave building erected for the purpoſes of ſupporting ſome ſtructure, or for making an eaſy paſſage over rivers. See ARCHITECTURE.

Triumphal ARCH, a ſtately gate of a ſemicircular form, adorned with ſculpture, inſcriptions, *&c.* erected in honour of thoſe who had deſerved a triumph.

ARCH, in compoſition, ſignifies chief, or of the firſt claſs, as archangel, archbiſhop, *&c.*

ARCHÆUS, or ARCHEUS. See ARCHEUS.

ARCHANGEL, an angel occupying the eighth rank in the celeſtial hierarchy.

ARCHANGEL, in botany. See LAMIUM.

ARCHANGEL, in geography, a city of the province of Dwina in Ruſſia, ſituated four miles from the White Sea, in 40° 12′ E. long. and 64° 30′ N. lat.

ARCHBISHOP, a prelate who has ſeveral ſuffragan biſhops under him. There are only two archbiſhops in England; the archbiſhop of Canterbury, who is primate of all England; and the archbiſhop of York, who is only ſtyled primate of England.

ARCHBISHOPRIC, in eccleſiaſtical geography, a province ſubject to the juriſdiction of an archbiſhop.

ARCHBUTLER, one of the great officers of the German empire, who preſents the cup to the emperor on ſolemn occaſions. This office belongs to the king of Bohemia.

ARCHCHAMBERLAIN, an officer of the empire, much the ſame with the great chamberlain in England. The elector of Brandenburg was appointed, by the golden bull, archchamberlain of the empire.

ARCHCHANCELLOR, an high officer who, in ancient times, preſided over the ſecretaries of the court. Under the two firſt races of the kings of France, when their territories were divided into Germany, Italy, and Arles, there were three archchancellors: and hence the three archchancellors ſtill ſubſiſting in Germany; the archbiſhop of Mentz being archchancellor of Germany, the archbiſhop of Cologn of Italy, and the archbiſhop of Treves of Arles.

ARCHCHANTOR, the preſident of the chantors of a church.

ARCHCOUNT, a title formerly given to the earl of Flanders.

ARCHDEACON, an eccleſiaſtical dignitary or officer next to a biſhop, whoſe juriſdiction extends either over the whole dioceſe, or only a part of it. There are 60 archdeacons in England, who viſit the pariſhes ſubject to their juriſdiction, inquire into abuſes, ſuſpend, excommunicate, *&c.* They likewiſe induct all clerks into their benefices.

ARCHDUKE, a title given to dukes of greater authority and power than other dukes. The archduke of Auſtria is among the moſt ancient: His principal privileges are, that he ſhall diſtribute juſtice in his own country, without appeal; that he cannot be deprived of his countries, even by the emperor and the ſtates of the empire; and that he have a power of creating counts, barons, *&c.* throughout the whole empire.

ARCHED, in a general ſenſe, denotes ſomething built or conſtructed in the faſhion or after the manner of an arch.

ARCHED *legs*, a fault in a horſe when his legs are bended archwiſe.

ARCHER, in the ancient military art, one who fought with bow and arrows. The Engliſh archers were eſteemed the beſt in Europe, to whoſe proweſs and dexterity the many victories over the French were in a great meaſure owing.

ARCHES-*court*, the chief and moſt ancient conſiſtory that belongs to the archbiſhop of Canterbury, for the debating of ſpiritual cauſes, ſo called from Bow-Church in London, where it is kept, whoſe top is raiſed of ſtone-pillars, built archwiſe. The judge of this court is termed the dean of the arches, or official of the arches-court: Dean of the arches, becauſe with this office is commonly joined a peculiar juriſdiction of thirteen pariſhes in London, termed a deanry, being exempted from the authority of the biſhop of London, and belonging to the archbiſhop of Canterbury; of which the pariſh of Bow is one. Some o-

thers ſay, that he was firſt called dean of the arches, becauſe the official to the archbiſhop, the dean of the arches, was his ſubſtitute in his court; and by that means the names became confounded. The juriſdiction of this judge is ordinary, and extends through the whole province of Canterbury; ſo that, upon any appeal, he forthwith, and without any further examination of the cauſe, ſends out his citation to the party appealed, and his inhibition to the judge from whom the appeal is made.

ARCHES, in geography, a name uſed among navigators for the Archipelago.

ARCHETYPE, the firſt model of a work, which is copied after to make another like it. Among minters, it is uſed for the ſtandard weight by which the others are adjuſted. The archetypal world, among Platoniſts, means the world as it exiſted in the idea of God, before the viſible creation.

ARCHEUS, among chemiſts, a term uſed to denote the predominating principle of things, whereby their peculiar qualities are fixed and determined.

ARCHILOCHIAN, a term in poetry, applied to a ſort of verſes, of which Archilochus was the inventor, conſiſting of ſeven feet, the four firſt whereof are ordinarily dactyls, though ſometimes ſpondees, the three laſt trochees; as in Horace,

Solvitur acris hyems, gratâ vice veris & Favoni.

ARCHIPELAGO, in geography, a general term for a ſea interrupted with iſlands; but more eſpecially denoting that between Greece and Aſia.

ARCHITECT, a perſon ſkilled in architecture.

ARCHITECTURE.

ARCHITECTURE, or the art of building, ought to be conſidered in a twofold light, as an object of taſte, and as a mechanical art. An examination of its principles improves our taſte; the practical part contains ſuch inſtructions as are neceſſary for the mechanic. Many books have been compoſed upon the mechanical part, but few authors have attempted to unfold the philoſophical principles of the art.

SECT. I.

OF ARCHITECTURE AS AN OBJECT OF TASTE.

MANY ages muſt have elapſed before architecture came to be conſidered as a fine art. Utility was its original deſtination, and ſtill continues to be its principal end. Experience, however, has taught us, that architecture is capable of exciting a variety of agreeable feelings. Of theſe, utility, grandeur, regularity, order, and proportion, are the chief.

Architecture being an uſeful as well as a fine art, leads us to diſtinguiſh buildings, and parts of buildings, into three kinds, *viz.* what are intended for uſe ſolely, what for ornament ſolely, and what for both. Buildings intended for utility ſolely, ought in every part to correſpond preciſely to that intention: The leaſt deviation from uſe, though contributing to ornament, will be diſagreeable; for every work of uſe being conſidered as a mean to an end, its perfection as a mean is the capital circumſtance, and every other beauty in oppoſition is neglected as improper. On the other hand, in ſuch things as are intended ſolely for ornament, as columns, obeliſks, triumphal arches, *&c.* beauty alone ought to be regarded. The principal difficulty in architecture lies in combining uſe and ornament. In order to accompliſh theſe ends, different and even oppoſite means muſt be employed; which is the reaſon why they are ſo ſeldom united in perfection; and hence, in buildings of this kind, the only practicable method is, to prefer utility to ornament according to the character of the building: In palaces, and ſuch buildings as admit of a variety of uſeful contrivance, regularity ought to be preferred; but in dwelling-houſes that are too ſmall for variety of contrivance, utility ought to prevail, neglecting regularity as far as it ſtands in oppoſition to convenience.

In conſidering attentively the beauty of viſible objects, we diſcover two kinds. The firſt may be termed *intrinſic* beauty, becauſe it is diſcovered in a ſingle object, without relation to any other. The ſecond may be termed *relative* beauty, being founded on a combination of relative objects. Architecture admits of both kinds. We ſhall firſt give a few examples of *relative* beauty.

The proportions of a door are determined by the uſe to which it is deſtined. The door of a dwelling-houſe, which ought to correſpond to the human ſize, is confined to ſeven or eight feet in height, and three or four in breadth. The proportions proper for a ſtable or coach-houſe are different. The door of a church ought to be wide, in order to afford an eaſy paſſage for a multitude; and its height muſt be regulated by its wideneſs, that the proportion may pleaſe the eye. The ſize of the windows

dows ought always to be proportioned to that of the room they are destined to illuminate; for if the apertures be not large enough to convey light to every corner, the room must be unequally lighted, which is a great deformity. Steps of stairs should likewise be accommodated to the human figure, without regarding any other proportion; they are accordingly the same in large and in small buildings, because both are inhabited by men of the same size.

We shall next consider *intrinsic* beauty, blended with that which is *relative*. A cube in itself is more agreeable than a parallelopipedon; this constantly holds in small figures: But a large building in the form of a cube is lumpish and heavy; while a parallelopipedon, set on its smaller base, is more agreeable on account of its elevation: Hence the beauty of Gothic towers. But if this figure were to be used in a dwelling-house, to make way for relative beauty, we would immediately perceive that utility ought chiefly to be regarded; and this figure, inconvenient by its height, ought to be set on its larger base: The loftiness in this case would be lost; but that loss will be more than sufficiently compensated by the additional convenience. Hence the form of buildings spread more upon the ground than raised in height, is always preferred for a dwelling-house.

With regard to the internal divisions, utility requires that the rooms be rectangular, to avoid useless spaces. An hexagonal figure leaves no void spaces; but it determines the rooms to be all of one size, which is both inconvenient and disagreeable for want of variety. Tho' a cube be the most agreeable figure, and may answer for a room of a moderate size; yet, in a very large room, utility requires a different figure. Unconfined motion is the chief convenience of a great room; to obtain this, the greatest length that can be had is necessary. But a square room of a large size is inconvenient. It removes chairs, tables, &c. at too great a distance from the hand, which, when unemployed, must be ranged along the sides of the room. Utility therefore requires a large room to be a parallellogram. This figure is likewise best calculated for the admission of light; because, to avoid cross-lights, all the windows ought to be in one wall; and if the opposite wall be at such a distance as not to be fully lighted, the room must be obscure. The height of a room exceeding nine or ten feet, has little relation to utility; therefore proportion is the only rule for determining the height, when above that number of feet.

Artists who deal in the beautiful, love to entertain the eye; palaces and sumptuous buildings, in which intrinsic beauty may be fully displayed, give them an opportunity of exerting their taste. But such a propensity is peculiarly unhappy with regard to private dwelling-houses; because in these, relative beauty cannot be displayed to perfection, without hurting intrinsic beauty. There is no opportunity for great variety of form in a small house; and in edifices of this kind, internal convenience has not hitherto been happily adjusted to external regularity. Perhaps an accurate coincidence in this respect is beyond the reach of art. Architects, however, constantly split upon this rock; for they never can be persuaded to give over attempting to reconcile these two incompatibles: How otherwise should it happen, that of the endless variety of private dwelling-houses, there should not be one found that is generally agreed upon as a good pattern? The unwearied propensity to make a house regular as well as convenient, obliges the architect, in some articles, to sacrifice convenience to regularity, and, in others, regularity to convenience; and accordingly the house, which turns out neither regular nor convenient, never fails to displease.

Nothing can be more evident, than that the form of a dwelling-house ought to be suited to the climate; yet no error is more common than to copy in Britain the form of Italian houses, not forgetting even those parts that are purposely contrived for collecting air, and for excluding the sun: Witness our colonnades and logios, designed by the Italians to gather cool air, and exclude the beams of the sun, conveniencies which the climate of this country does not require.

We shall next view architecture as one of the fine arts; which will lead us to the examination of such buildings, and parts of buildings, as are calculated solely to please the eye. Variety prevails in the works of nature; but art requires to be guided by rule and compass. Hence it is, that in such works of art as imitate nature, the great art is, to hide every appearance of art; which is done by avoiding regularity, and indulging variety. But in works of art that are original and not imitative, such as architecture, strict regularity and uniformity ought to be studied, so far as consistent with utility.

Proportion is not less agreeable than regularity and uniformity; and therefore, in buildings intended to please the eye, they are all equally essential. It is taken for granted by many writers, that in all the parts of a building there are certain strict proportions which please the eye, in the same manner as in sound there are certain strict proportions which please the ear; and that, in both, the slightest deviation is equally disagreeable. Others seem to relish more a comparison between proportion in numbers, and proportion in quantity; and maintain, that the same proportions are agreeable in both. The proportions, for example, of the numbers 16, 24, and 36, are agreeable; and so, say they, are the proportions of a room, whose height is 16 feet, the breadth 24, and the length 36. But it ought to be considered, that there is no resemblance or relation between the objects of different senses. What pleases the ear in harmony, is not the proportion of the strings of the instrument, but of the sound which these strings produce. In architecture, on the contrary, it is the proportion of different quantities that pleases the eye, without the least relation to sound. The same thing may be said of numbers. Quantity is a real quality of every body; number is not a real quality, but merely an idea that arises upon viewing a plurality of things in succession. An arithmetical proportion is agreeable in numbers; but have we from this any reason to conclude, that it must also be agreeable in quantity? At this rate, a geometrical proportion, and many others, ought also to be agreeable in both. A certain proportion may coincide in quantity and number; and amongst an endless variety of proportions, it would be wonderful if there never should be a

coincidence.

coincidence. One example is given of this coincidence, in the numbers 16, 24, and 36; but to be convinced that it is merely accidental, we need but reflect, that the fame proportions are not applicable to the external figure of a houfe, and far lefs to a column.

It is ludicrous to obferve writers acknowledging the neceffity of accurate proportions, and yet differing widely about them. Laying afide reafoning and philofophy, one fact univerfally agreed on ought to have undeceived them, that the fame proportions which pleafe in a model are not agreeable in a large building: A room 48 feet in length, and 24 in breadth and height, is well proportioned; but a room 12 feet wide and high, and 24 long, approaches to a gallery.

Perrault, in his comparifon of the ancients and moderns, goes to the oppofite extreme, maintaining, that the different proportions affigned to each order of columns are arbitrary, and that the beauty of thefe proportions is entirely the effect of cuftom. But he fhould have confidered, that if thefe proportions had not originally been agreeable, they could never have been eftablifhed by cuftom.

For illuftrating this point, we fhall add a few examples of the agreeablenefs of different proportions. In a fumptuous edifice, the capital rooms ought to be large, otherwife they will not be proportioned to the fize of the building; for the fame reafon, a very large room is improper in a fmall houfe. But in things thus related, the mind requires not a precife or fingle proportion, rejecting all others; on the contrary, many different proportions are equally agreeable. It is only when a proportion becomes loofe and diftant, that the agreeablenefs abates, and at laft vanifhes. Accordingly, in buildings, rooms of different proportions are found to be equally agreeable, even where the proportion is not influenced by utility. With regard to the proportion the height of a room fhould bear to the length and breadth, it muft be extremely arbitrary, confidering the uncertainty of the eye as to the height of a room when it exceeds 16 or 17 feet. In columns, again, every architect muft confefs, that the proportion of height and thicknefs varies betwixt 8 diameters and 10, and that every proportion between thefe two extremes is agreeable. Befides, there muft certainly be a further variation of proportion, depending on the fize of the column: A row of columns 10 feet high, and a row twice that height, requires different proportions: The intercolumniations muft alfo differ in proportion according to the height of the row.

Proportion of parts is not only itfelf a beauty, but is infeparably connected with a beauty of the higheft relifh, that of concord and harmony; which will be plain from what follows: A room, the parts of which are all finely adjufted to each other, ftrikes us not only with the beauty of proportion, but with a pleafure far fuperior. The length, the breadth, the height, the windows, raife each of them a feparate emotion: Thefe emotions are fimilar; and, though faint when feparately felt, they produce, in conjunction, the emotion of concord or harmony, which is very pleafant. On the other hand, where the length of a room far exceeds the breadth, the mind, comparing together parts fo intimately connected, immediately perceives a difagreement or difproportion which difgufts. Hence a long gallery, however convenient for exercife, is not an agreeable figure of a room.

In buildings deftined chiefly or folely to pleafe the eye, regularity and proportion are effentially neceffary, becaufe they are the means of producing intrinfic beauty. But a fkilful artift will not confine his view to regularity and proportion; he will alfo ftudy congruity, which is perceived when the form and ornaments of a ftructure are fuited to the purpofe for which it is appointed. Hence every building ought to have an expreffion fuited to its deftination. A palace ought to be fumptuous and grand; a private dwelling, neat and modeft; a playhoufe, gay and fplendid; and a monument, gloomy and melancholy. A heathen temple has a double deftination: It is confidered as a houfe dedicated to fome divinity; therefore it ought to be grand, elevated, and magnificent: It is alfo confidered as a place of worfhip; and therefore ought to be fomewhat dark and gloomy, becaufe dimnefs or obfcurity produces that tone of mind which is favourable to humility and devotion. Columns, befides their chief deftination of being fupports, contribute to that peculiar expreffion which the deftination of a building requires: Columns of different proportions ferve to exprefs loftinefs, lightnefs, *&c.* as well as ftrength. Situation may alfo contribute to expreffion: Conveniency regulates the fituation of a private dwelling-houfe; and the fituation of a palace ought to be lofty. This leads to a queftion, Whether the fituation, where there happens to be no choice, ought, in any meafure, to regulate the form of the edifice? The connection between a great houfe and a neighbouring field, though not extremely intimate, demands however fome congruity. It would, for example, difpleafe us to find an elegant building thrown away upon a wild uncultivated country: Congruity requires a polifhed field for fuch a building. The old Gothic form of building was well fuited to the rough uncultivated regions where it was invented; but was very ill adapted to the fine plains of France and Italy.

The external ftructure of a houfe leads naturally to its internal ftructure. A large and fpacious room, which is the firft that commonly receives us, is a bad contrivance in feveral refpects. In the firft place, when immediately from the open air we ftep into fuch a room, its fize in appearance is diminifhed by contraft; it looks little, compared with the great canopy of the fky. In the next place, when it recovers its grandeur, as it foon doth, it gives a diminutive appearance to the reft of the houfe; paffing from it, every apartment looks little. In the third place, by its fituation it ferves only for a waiting-room, and a paffage to the principal apartments. Rejecting therefore this form, a hint may be taken from the climax in writing for another that appears more fuitable: A handfome portico, proportioned to the fize and fafhion of the front, leads into a waiting-room of a larger fize, and this to the great room, all by a progreffion from fmall to great.

Grandeur is the principal emotion that architecture is capable of raifing in the mind: it might therefore be the chief ftudy of the artift, in great buildings deftined

to

to pleafe the eye. But as grandeur depends partly on fize, it is unlucky for architecture that it is governed by regularity and proportion, which never deceive the eye by making objects appear larger than they are in reality. But though regularity and proportion contribute nothing to grandeur, fo far as that emotion depends on fize; yet they contribute greatly to it by confining the fize within fuch bounds that it can be taken in and examined at one view; for, when objects are fo large as not to be comprehended but in parts, they tend rather to diftract than fatisfy the mind.

We fhall next pafs to fuch ornaments as contribute to give buildings a peculiar expreffion. It has been doubted, whether a building can regularly admit any ornament but what is ufeful, or at leaft has that appearance. But, confidering the double aim of architecture as a fine, as well as an ufeful art, there is no reafon why ornaments may not be added to pleafe the eye, without any relation to utility. A private dwelling-houfe, it is true, and other edifices, where ufe is the chief aim, admit not regularly any ornament but what has at leaft the appearance of ufe: But temples, triumphal arches, and other buildings intended chiefly or folely for fhow, may be highly ornamented.

This fuggefts a divifion of ornaments into three kinds, *viz.* 1. Ornaments that are beautiful without relation to ufe; fuch as ftatues, vafes, baffo or alto relievo: 2. Things in themfelves not beautiful, but poffeffing the beauty of utility, by impofing on the fpectator, and appearing to be ufeful; fuch as blind windows: 3. Where things are beautiful in themfelves, and at the fame time take on the appearance of ufe; fuch as pilafters.

With regard to the *firft*, we naturally require that a ftatue be fo placed, as to be feen in every direction, and examined at different diftances. Statues, therefore, are properly introduced to adorn the great ftair that leads to to the principal door of a palace, or to leffen the void between pillars. But a niche in the external front is an improper place for a ftatue. There is an additional reafon againft placing them upon the roof or top of the walls; their ticklifh fituation gives pain, as they have the appearance of being in danger of tumbling down; befides, we are inclined to feel from their being too much expofed to the inclemencies of the weather. To adorn the top of the wall with a row of vafes, is an unhappy conceit, by placing a thing, whofe natural deftination is utility, where it cannot have even the appearance of ufe. As to carvings upon the external furface of a building, termed *baffo relievo* when flat, and *alto relievo* when prominent, all contradictory expreffions ought to be avoided. Now, firmnefs and folidity being the proper expreffions of a pedeftal, and, on the contrary, lightnefs and delicacy of carved work, the pedeftal, whether of a column or of a ftatue, ought to be fparingly ornamented. The ancients never ventured any bolder ornament than the baffo relievo.

With refpect to ornaments of the *fecond* kind, it is a great blunder to contrive them fo as to make them appear ufelefs. A blind window, therefore, when neceffary for regularity, ought to be fo difguifed as to appear a real window: When it appears without difguife, it is difguftful, as a vain attempt to fupply the want of invention; it fhows the irregularity in a ftronger light, by fignifying that a window ought to be there in point of regularity, but that the architect had not fkill fufficient to connect external regularity with internal convenience.

As to the *third*, it is an error to fink pilafters fo far into the wall, as to remove totally, or moftly, the appearance of ufe. They fhould always project fo much from the wall, as to have the appearance of fupporting the entablature over them.

From ornaments in general, we defcend to a pillar, the chief ornament in great buildings. The deftination of a pillar is to fupport, really or in appearance, another part termed the *entablature*. With regard to the form of a pillar, it muft be obferved, that a circle is a more agreeable figure than a fquare, a globe than a cube, and a cylinder than a parallellopipedon. This laft, in the language of architecture, is faying, that a column is a more agreeable figure than a pilafter; and for that reafon it ought to be preferred, when all other circumftances are equal. Another reafon concurs, that a column annexed to a wall, which is a plain furface, makes a greater variety than a pilafter. Befides, pilafters at a diftance are apt to be miftaken for pillars; and the fpectator is difappointed when, on a nearer approach, he difcovers them to be only pilafters.

As to the parts of a column, a bare uniform cylinder, without a capital, appears naked; and without a bafe, appears too ticklifhly placed to ftand firm. It ought therefore to have fome finifhing at the top and bottom: Hence the three chief parts of a column, the fhaft, the bafe, and the capital. Nature undoubtedly requires proportion among thefe parts, but it admits of variety of proportion. Vitruvius and fome of the elder writers feem to think, that the proportions of columns were derived from the human figure, the capital reprefenting the head, the bafe the feet, and the fhaft the body. The Tufcan has been accordingly denominated the *Gigantic*; the Doric, the *Herculean*; the Ionic, the *Matronal*; and the Corinthian, the *Virginal*:—the Compofite is a mixture of the Corinthian and Ionic. As to the bafe, the principle of utility interpofes to vary it from the human figure, and to proportion it fo to the whole, as to give the column the appearance of ftability.

Among the Greeks, we find only three orders of columns, the Doric, the Ionic, and the Corinthian, diftinguifhed from each other by their deftination as well as by their ornaments. It has been difputed, whether any new order can be added to thefe: Some hold the affirmative, and give for inftances the Tufcan and Compofite; others maintain, that thefe properly are not diftinct orders, but only the original orders with fome flight variation. The only circumftances that can ferve to diftinguifh one order from another, are the form of the column, and its deftination. To make the firft a diftinguifhing mark without regard to the other, would multiply orders without end. Deftination is more limited, and it leads us to diftinguifh three kinds of orders; one plain and ftrong, for the purpofe of fupporting plain and maffy buildings; one delicate and graceful, for fupporting buildings of that character; and between thefe, a third,

third, ſupporting buildings of a mixed nature. So that, if deſtination alone is to be regarded, the Tuſcan is of the ſame order with the Doric, and the Compoſite with the Corinthian.

The ornaments of theſe three orders ought to be ſuited to the purpoſes for which they are intended. Plain and ruſtic ornaments would be not a little diſcordant with the elegance of the Corinthian order, and ſweet and delicate ornaments not leſs with the ſtrength of the Doric.

With reſpect to buildings of every kind, one rule, dictated by utility, is, that they be firm and ſtable. Another, dictated by beauty, is, that they alſo appear ſo to the eye; for every thing that appears tottering, and in hazard of tumbling down, produceth in the ſpectator the painful emotion of fear, inſtead of the pleaſing emotion of beauty; and accordingly it ſhould be the great care of the artiſt, that every part of his edifice appear to be well ſupported. Some have introduced a kind of conceit in architecture, by giving parts of buildings the appearance of falling; of this kind is the church of St Sophia in Conſtantinople; the round towers in the uppermoſt ſtories of Gothic buildings is in the ſame falſe taſte.

SECT. II.

OF ARCHITECTURE AS A MECHANICAL ART.

Of the Origin *of* Buildings.

Buildings, in the firſt ages of ſociety, behoved to be extremely rude. The firſt huts were probably of a conic figure, being the moſt ſimple, and beſt adapted to the materials that could be obtained in ſuch an uncultivated ſtate of ſociety. Theſe huts were formed of branches of trees, covered with reeds, leaves, and clay.

But, finding the conic figure inconvenient, on account of its inclined ſides, they changed it into a cubical one, in the following manner: They fixed in the ground ſeveral upright trees to form the ſides, filling the intervals between them with branches cloſely interwoven, and covered with clay. The ſides being thus compleated, four large beams were placed on the upright trunks, which, being well joined at the angles, kept the ſides firm; and likewiſe ſerved to ſupport the roof, which was compoſed of many joiſts, covered with reeds, leaves, and clay.

As men improved in the art of building, new methods of rendering their huts laſting and handſome were gradually invented. They took off the bark and other unevenneſſes from the trunks of the trees that formed the ſides, and raiſed them above the dirt on ſtones. The ſpaces between the ends of the joiſts were cloſed with clay, and the ends of them were covered with thin boards, cut in the form of triglyphs, *&c.*

From this ſimple conſtruction the different orders of architecture took their riſe. When buildings of wood were laid aſide, they imitated, in their edifices of ſtone, the form which neceſſity had introduced into the primitive huts: Hence the upright trees gave riſe to the columns; and the beams, joiſts, rafters, and ſtrata of materials that formed the covering, ſuggeſted architraves, frizes, triglyphs, and cornices.

At what time, or by whom, the Grecian orders were invented, is not certainly known. But the following is the account which Vitruvius gives of them.

Dorus, king of Achaia, and ſon of Helenes and Optica, built a temple to Juno in the ancient city of Argos, which happened to be in the manner now called *Doric*, from the name of the inventor. This manner was afterwards imitated in many other temples in the ſeveral cities of Achaia.

The Athenians, about the ſame time, ſent thirteen colonies into Aſia, under the command of Ion, ſon of Xuthus and Creuſa. This Ion conquered all Caria, founded many cities, and called the country *Ionia*. The firſt temple he built was after the Doric manner. But afterwards he built a temple to Diana of a more delicate ſtructure, and formed upon the proportions of a female body, as the Doric had been on thoſe of a robuſt man. The capital was adorned with volutes, to repreſent the curls of a woman's hair; and flutings were cut on the ſhaft of the column, in imitation of the folds of her garment. This order got the name of *Ionic*, in honour of the Ionians who invented it.

The third ſort of columns, called *Corinthian*, are ſaid to owe their origin to the following accident:—A young girl of Corinth having died, her nurſe placed on her tomb a baſket, containing certain trinkets, in which ſhe delighted when alive, and covered it with a tyle to prevent the rain from ſpoiling them. The baſket happened to be placed on a root of acanthus, which puſhing out its leaves in the ſpring, covered the ſides of the baſket; ſome of the longeſt of which, being obſtructed by the corners of the tyle, were forced downwards, and curled in the manner of volutes. Calimachus the ſculptor, paſſing near the tomb, was ſo pleaſed with the beautiful appearance of the acanthus growing in this manner, that he imitated it in the columns which he afterwards made at Corinth.

Villalpandus treats this ſtory of Calimachus as a fable, and maintains that the Corinthian capital took its origin from an order in Solomon's temple; and it muſt be acknowledged, that ſome deſcriptions in the Bible favour this opinion.

Beſides theſe three orders, ſaid to be invented by the Greeks, two other, *viz.* the Tuſcan and Compoſite, are thought to have been invented by the Romans. The Tuſcan firſt appeared in Tuſcany, before the Romans had any intercourſe with the Greeks. The Compoſite is a mixture of the Ionic and Corinthian. Theſe five manners of building, invented by the ancients, are called Orders, on account of the regularity and beauty of their forms.

Of

Of the PARTS *that compoſe an* ORDER, *and their* ORNAMENTS.

THE parts that compoſe an order may be diſtributed into two different claſſes. In the *firſt* may be ranged all that have any analogy to the primitive huts, and repreſent ſome part that was neceſſary in their conſtruction. Such are the ſhaft of the column, with the plinth of its baſe, and the abacus of its capital, repreſenting the upright trees, with the ſtones on which they were placed, and thoſe that covered them; likewiſe the architrave and triglyphs, repreſenting the beams and joiſts; the mutules, modilions, or dentils, which all of them repreſent the rafters, or ſome other pieces of timber uſed to ſupport the covering; and the corona, repreſenting the beds of materials that compoſed the covering. All theſe may properly be diſtinguiſhed by the name of eſſential members. The ſubſervient parts, contrived for the uſe or ornament of the former, and commonly called mouldings, may conſtitute the *ſecond* claſs.

THERE are eight regular mouldings in ornamenting columns; the fillet, liſtel, or ſquare; the aſtragal, or bead; the torus, or tore; the ſcotia, mouth, or caſement; the echinus, ovolo, or quarter-round; the inverted cyma, talon, or ogee; the cyma, cyma recta, or cymatium; the cavetto, or hollow. The names of theſe allude to their forms, and their forms are adapted to the purpoſes for which they are intended. See Plate XXVII.

The ovolo and talon, as they are ſtrong at the extremities, are fit for ſupports; the cyma and cavetto, tho' improper for ſupports, ſerve for coverings to ſhelter other members; the torus and aſtragal, being ſhaped like ropes, are intended to bind and fortify the parts with which they are connected: But the uſe of the ſcotia and fillet, is only to ſeparate and diſtinguiſh the other mouldings, to give a graceful turn to the profile, and to prevent the confuſion which would ariſe from joining ſeveral curved members together.

There are various methods of deſcribing the contours of mouldings; but the ſimpleſt and beſt is to form them of quadrants of circles, as in Plate XXVII.

An aſſemblage of what are called eſſential parts and mouldings, is termed a *profile*. The moſt perfect profiles are ſuch as are compoſed of few mouldings, varied in form and ſize; and ſo diſpoſed, that the ſtreight and curved ones ſucceed each other alternately. When ornaments are employed in mouldings, ſome of them ſhould be left plain, in order to give a proper repoſe: For, when all are ornamented, the figure of the profile is loſt.

Of the ORDERS *of* ARCHITECTURE.

AN ORDER conſiſts of two principal members, the COLUMN and the ENTABLATURE; each of which is compoſed of three principal parts. Thoſe of the Column are, the *Baſe*, the *Shaft*, and the *Capital*; and thoſe of the Entablature are, the *Architrave*, the *Frize*, and the *Cornice*. All theſe are ſubdivided into many leſſer parts, whoſe number, form, and dimenſions characteriſe each order, and expreſs the degree of ſtrength, delicacy, richneſs, or ſimplicity peculiar to it.

1. OF THE TUSCAN.

THE TUSCAN (Plate XXIV.) is the moſt ſolid and ſimple of all the orders. It is compoſed of few parts, devoid of ornaments, and ſo maſſy, that its ſeems capable of ſupporting the heavieſt burden. There are no remains of a regular Tuſcan order among the antiques; the doctrine of Vitruvius concerning it is obſcure; and the profiles of Palladio, Scamozzi, Serlio, de l'Orme, and Vignola, are all imperfect.

The height of the Tuſcan column is 14 modules, or ſemidiameters, each conſiſting of 30 minutes; and that of the whole entablature $3\frac{1}{2}$ modules; which being divided into 10 equal parts, three of them are for the height of the architrave, three for the freeze, and the remaining four for the cornice: The capital is one module; the baſe, including the lower cincture of the ſhaft, is likewiſe one module; and the ſhaft, with its upper cincture and aſtragal, 12 modules.

Theſe are the general dimenſions of the order; the particular dimenſions may be learned by inſpection of the plates.

In the remains of antiquity, the quantity of diminution at the top of the Tuſcan column is various; but ſeldom leſs than one eighth, nor more than one ſixth of the inferior diameter of the column. The laſt of theſe is generally preferred; and Chalmers and others make the ſame diminution in all columns, without regard to their order.

2. OF THE DORIC ORDER.

THE DORIC ORDER, (Plate XXV.) is next in ſtrength to the Tuſcan; and being of a grave, robuſt, and maſculine aſpect, is by Scamozzi called the Herculean. As it is the moſt ancient of all the orders, it retains more of the ſtructure of the primitive huts than any of the reſt; the triglyphs in its freeze repreſenting the ends of the joiſts; and the mutules in its cornice, repreſenting the rafters.

The height of the Doric column, including its capital and baſe, is 16 modules, and the height of the entablature four; the latter of which being divided into eight parts, two of them are for the architrave, three for the frize, and three for the cornice.

In moſt of the antiques, the Doric column is executed without a baſe. Vitruvius likewiſe makes it without one; the baſe, according to him, having been firſt employed in the Ionic order, in imitation of the ſandal of a woman's foot. Scamozzi blames this practice, and moſt of the modern architects are of his opinion.

In the profile of the theatre of Marcellus, the frize is enriched with huſks and roſes; the architrave conſiſts only of one faſcia and a fillet; the drops are conical; the metope is enriched with a bull's ſkull, adorned with a garland of beads, in imitation of thoſe on the temple of Jupiter Tonans at the foot of the Capitol. In ſome antique fragments, and in a great many mordern buildings, the metopes are alternately adorned with ox-ſkulls and pateras. But they may be filled with any other ornaments, according to the deſtination of the building.

OF THE IONIC ORDER.

The Ionic Order (Plate XXVI.) is of a more ſlender make than the Doric or Tuſcan; its appearance is ſimple, yet graceful and majeſtic; its ornaments are few; ſo that it has been compared to a ſedate matron, in decent, rather than magnificent attire.

Among the ancients, the form of the Ionic profile appears to have been more poſitively determined than that of any other order; for, in all the antiques at Rome, (the temple of Concord excepted) it is exactly the ſame.

The modern artiſts have likewiſe been unanimous in their opinions; all of them, excepting Palladio and his imitators, having employed the dentil, cornice, and the other parts of the profile, nearly as they are found in the Colliſeum, the temple of Fortune, and the theatre of Marcellus.

The height of the Ionic column is 18 modules, and that of the entablature $4\frac{1}{2}$, or one quarter of the height of the column, as in the other orders, which is a trifle leſs than in any of the antique Ionics. In all the antiques, the baſe is Attic; and the ſhaft of the column may either be plain, or fluted with 24 flutings, or 20 only, as in the temple of Fortune. The plan of the flutings may be a trifle more than a ſemicircle, as in the forum of Nerva, becauſe they then appear more diſtinct. The fillets, or intervals between them, muſt not be broader than one third of the breadth of a fluting, nor narrower than one fourth. The ornaments of the capital muſt correſpond with the flutings of the ſhaft; and there muſt be an ove above the middle of each fluting. The volutes ought to be traced according to Mr Goldman's method, which is as follows:

Plate XXVII. fig. 9. Draw the cathetus F C, whoſe length muſt be 15 minutes, or one fourth of a module; and, from the point C, deſcribe the eye of the volute A E B D, of which the diameter is to be $6\frac{2}{3}$ minutes; divide it into four equal ſectors by the diameters A B, D E. Biſect the radii C A, C B, in 1 and 4; and on the line 1, 4, conſtruct a ſquare 1, 2, 3, 4. From the centre C, to the angles 2, 3, draw the diagonals C 2, C 3, and divide the ſide of the ſquare 1, 4, into 6 equal parts, at 5, 9, C, 12, 8. Then through the points 5, 9, 12, 8, draw the lines 5, 6, 9, 10, 12, 11, 8, 7, parallel to the diameter E D, which will cut the diagonals in 6, 7, 10, 11; and the points 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, will be the centres of the volute. From the firſt centre 1, with the diſtance 1 F, deſcribe the quadrant F G; from the ſecond centre 2, with the diſtance 2 G, deſcribe the quadrant G H; and, continuing the ſame operation from all the 12 centres, the contour of the volute will be completed.

Fig. 10. The centres for deſcribing the fillet are found in this manner. Conſtruct a triangle, of which the ſide A F is equal to the part of the cathetus contained between A F and the ſide F V, equal to C 1; place the diſtance F S from F towards A, equal to F S the breadth of the fillet, and through the point S draw the line S T, which will be to C 1 in the ſame proportion as A S is to A F; place this line on the diameter of the eye A B; divide it into three equal parts; and, through the points of diviſion, draw lines parallel to the diameter E D, which will cut the diagonals C 2, C 3, and you will have twelve new centres, from whence the interior contour of the fillet may be deſcribed, in the ſame manner as the exterior one was from the firſt centres.

4. OF THE CORINTHIAN ORDER.

The proportions of this order are extremely delicate. It is divided into a great variety of members, and enriched with a profuſion of ornaments. Scamozzi calls it the *virginal order*; and indeed it has all the delicacy in its make, and all the gaiety in its dreſs, peculiar to young girls. See Plate XXVIII.

The moſt perfect model of the Corinthian order is generally allowed to be in the three columns in the Campo Vaccino at Rome, the remains, as it is thought, of the temple of Jupiter Stator.

The Corinthian column ſhould be 20 modules high, and the entablature 5; which proportions are a medium between thoſe of the Panthæon and the three columns. The baſe of the column may either be Attic or Corinthian: They are both beautiful. If the entablature be enriched, the ſhaft may be fluted. The flutings may be filled, to one third of their height, with cablings, as in the inſide of the Panthæon; which will ſtrengthen the lower part of the column, and make it leſs liable to injury.

In moſt of the antiques at Rome, the capital of this order is enriched with olive-leaves; the acanthus being ſeldom employed but in the Compoſite. De Cordemoy, however, prefers the acanthus.

The diviſions of the entablature bear the ſame proportions to each other, as in the Tuſcan, Ionic, and Compoſite orders.

5. OF THE COMPOSITE.

The Composite is, ſtrictly ſpeaking, only a ſpecies of the Corinthian; and therefore retains, in a great meaſure, the ſame character. See Plate XXIX.

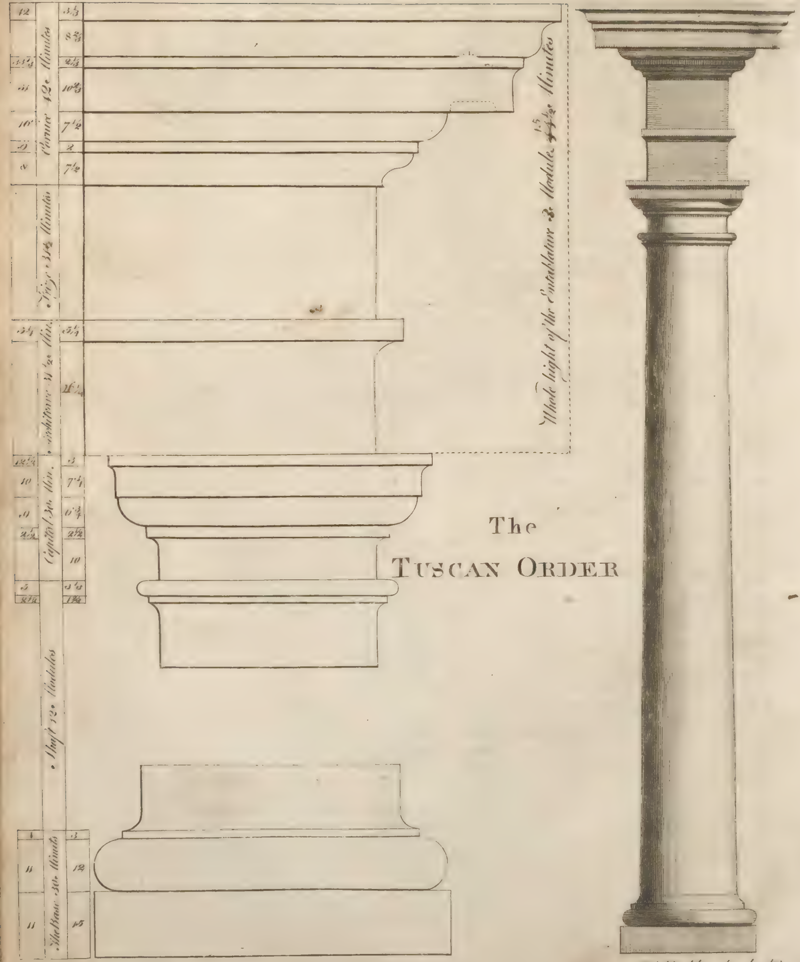
It does not appear that the ancients affected any particular form of entablature to this order. Sometimes the cornice is entirely plain, as in the temple of Bacchus; at others, as in the arch of Septimius Severus, it is enriched with dentils differing very little from the Ionic; and in the arch of Titus, there are both dentils and modilions; the whole form of the profile being the ſame with the Corinthian, as executed in the antiques at Rome.

The modern architects have varied more in this than in any other order, each following the bent of his own fancy.

The height of the Compoſite column, and parts of the entablature, is the ſame with that of the Corinthian. The foot of the leaves of the capital ought not to project beyond the upper part of the ſhaft. The different bunches of leaves ſhould be ſtrongly marked; the ſprigs which ariſe between the upper ones ſhould be kept flat upon the vaſe; and the ornaments of the volutes muſt not project beyond the fillets that incloſe them.

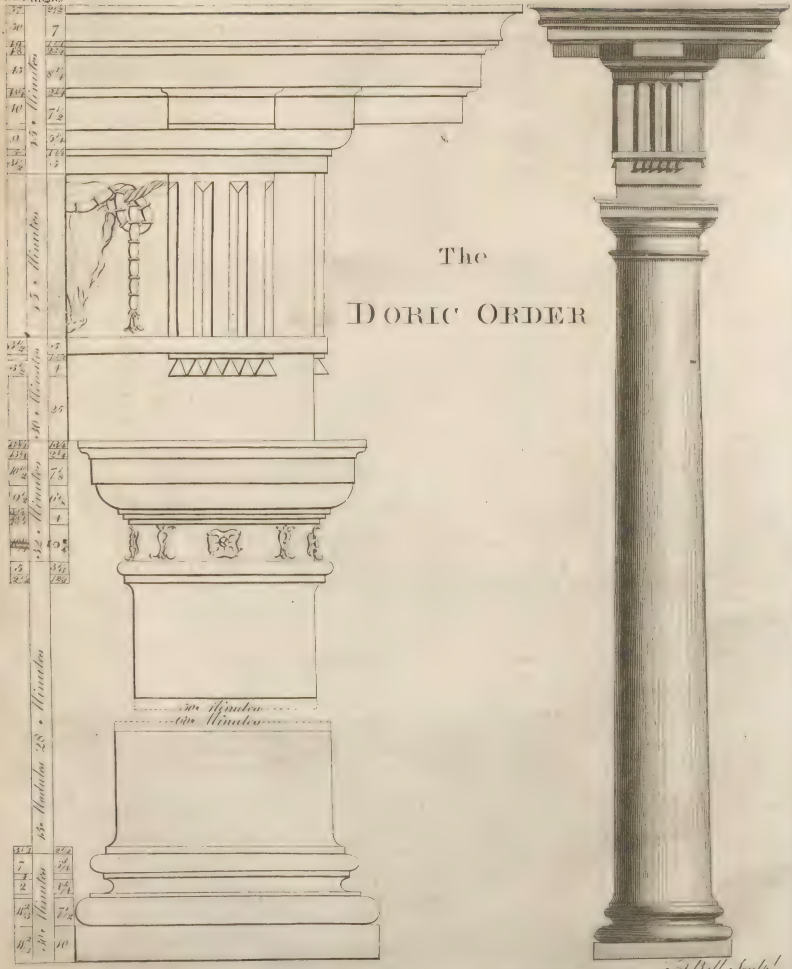
OF

Plate XXIV.

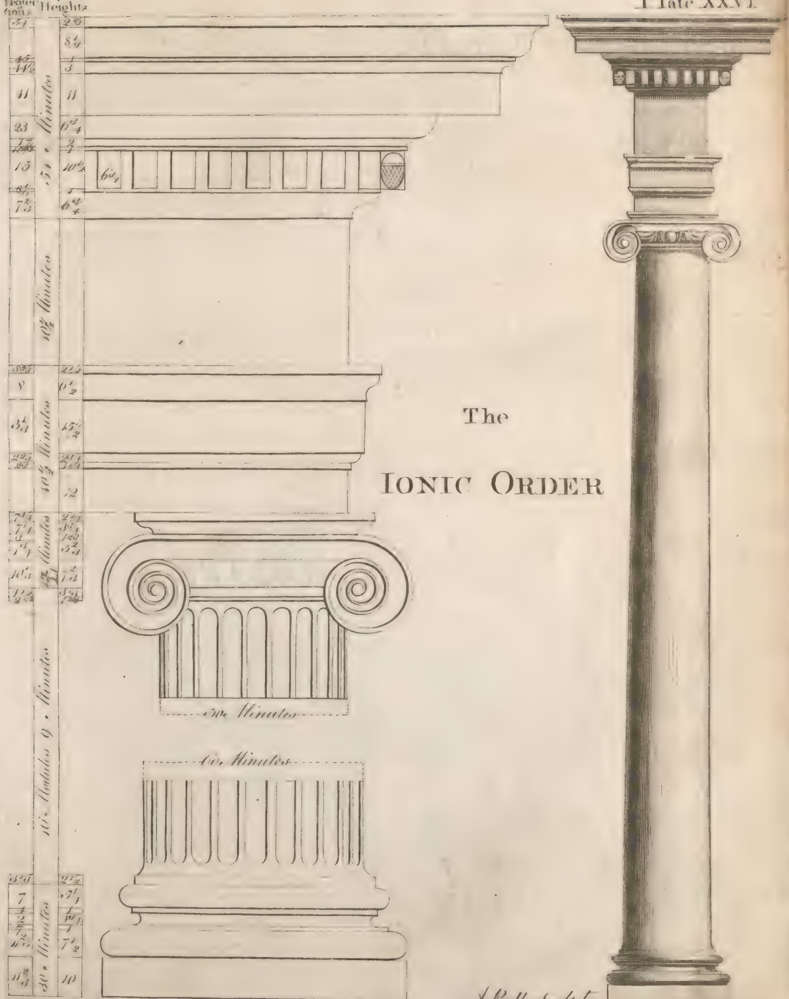


The TUSCAN ORDER

A. Bell Sculpt.


Projections
Hights
The
DORIC ORDER
15 Minutes
45 Minutes
30 Minutes
32 Minutes
30 Minutes
60 Minutes
Modules 28 Minutes
30 Minutes

J. Bell Sculp.


Projections
Heights
31 • Minutes
10 3/4 Minutes
40 1/2 Minutes
9 • Modules 9 • Minutes
30 • Minutes
30 Minutes
60 Minutes
The
Ionic Order
A Bell Sculp.


V
T
F
S

Plate. XXVII

Fig. 1.
Fillet. List

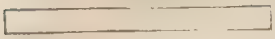


Fig. 2.
Astragal

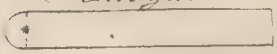


Fig. 3.
Torus

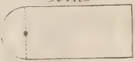


Fig. 4.
Scotia. Mouth

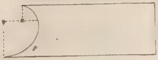


Fig. 5.
Ovolo

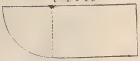


Fig. 6.
Ogee

Fig. 7.
Cyma Recta

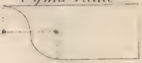


Fig. 8.
Cavetto

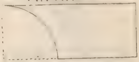


Fig. 9.
VOLUTE

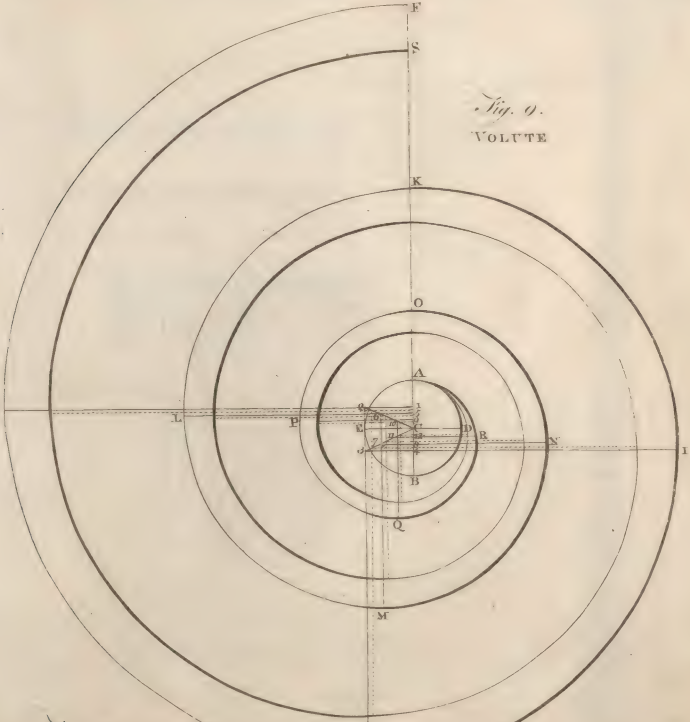


Fig. 10.

A. Bell Sculp.

Plate XXVIII.

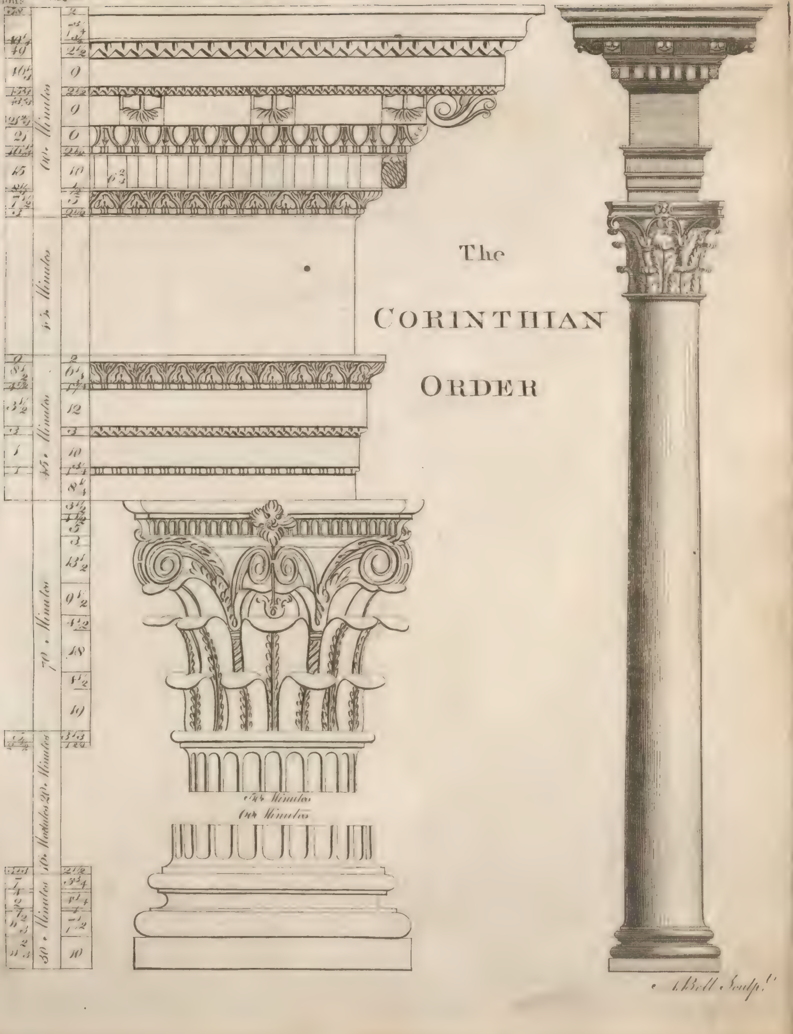
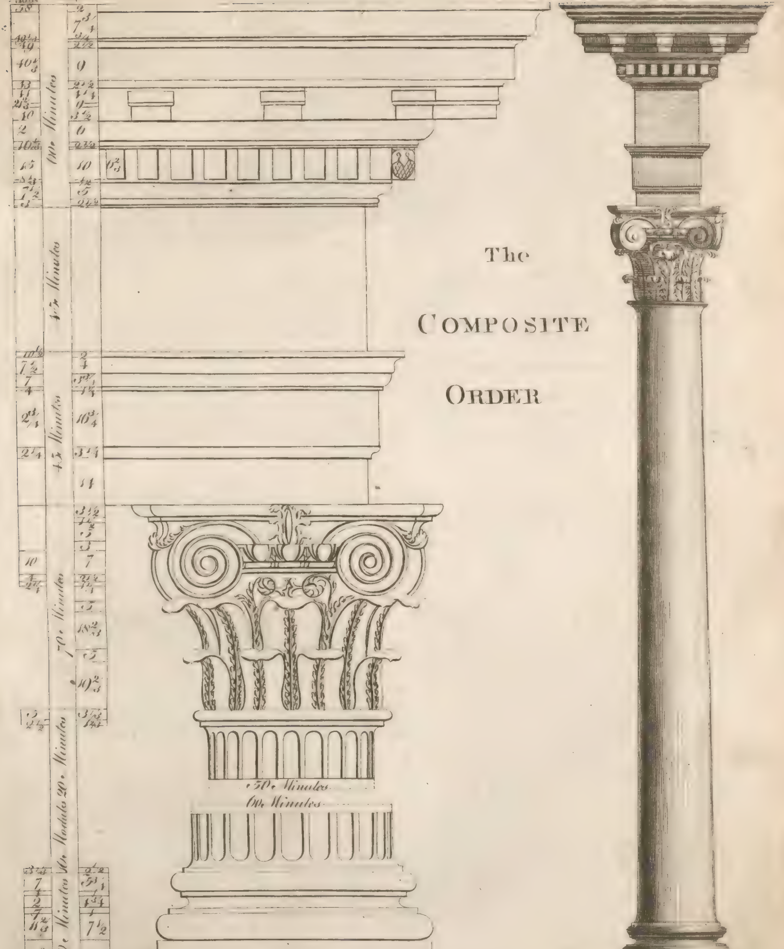


Plate XXIX.


Projections
Hights
The
Composite
Order
90. Minutes
45. Minutes
45. Minutes
70. Minutes
30. Minutes
50. Minutes
60. Minutes
30. Modules 20. Minutes
A. Bell Sculp.t

OF PILASTERS.

PILASTERS differ from columns only in their plan; which is ſquare, as that of columns is round. Their baſes, capitals, and entablatures, have the ſame parts, with the ſame heights and projections, as thoſe of columns: They are alſo diſtinguiſhed in the ſame manner, by the names of Tuſcan, Doric, Ionic, Corinthian, and Compoſite.

The column is undoubtedly more perfect than the pilaſter. However, they may be employed with great propriety on many occaſions. Some authors declaim againſt pilaſters, becauſe, according to them, they do not admit of diminution. But this is a miſtake; there are many inſtances, in the remains of antiquity, of their being diminiſhed. Scamozzi always gave his pilaſters the ſame diminution as his columns: Palladio and Inigo Jones have likewiſe diminiſhed them in many of their buildings.

Pilaſters are employed in churches, galleries, halls, and other interior decorations, to ſave room; for, as they ſeldom project beyond the ſolid wall above one quarter of their diameter, they do not occupy near ſo much ſpace as columns. They are likewiſe uſed in exterior decorations; ſometimes alone, inſtead of columns, on account of their being leſs expenſive; and ſometimes they accompany columns, being placed behind them to ſupport the architraves, where they enter the building, as in the Panthæon at Rome; or, in the ſame line with them, to fortify the angles, as in the portico of Septimius.

When pilaſters are uſed alone, they ſhould project one quarter of their diameter beyond the walls. When placed behind columns, eſpecially if they be very near them, they need not project above one eighth of their diameter. But, when placed on a line with columns, their projection muſt be regulated by that of the columns; and conſequently, it can never be leſs than a ſemidiameter, even when the columns are engaged as much as poſſible.

The ſhafts of pilaſters are frequently adorned with flutings, in the ſame manner as thoſe of columns; the plan of which may be a trifle more than a ſemicircle: Their number muſt be ſeven on each face, which makes them nearly of the ſame ſize with thoſe of columns. The intervals, or fillets, muſt either be one third or one fourth of the fluting in breadth.

The capitals of pilaſters are profiled nearly in the ſame manner as thoſe of columns.

OF PERSIANS AND CARYATIDES.

BESIDES columns and pilaſters, it is ſometimes cuſtomary to employ repreſentations of the human figure, to ſupport entablatures in buildings. The male figures are called *Perſians*; and the female, *Carians*, or *Caryatides*. The ancients made frequent uſe of Perſians and Caryatides, and delighted in diverſifying them a thouſand ways. The modern artiſts have followed their example; and there is a great variety of compoſitions of this kind to be met with in different parts of Europe.

Indecent attitudes, diſtorted features, and all monſtrous productions, ought to be avoided, of which there are many examples in Gothic buildings. On the contrary, the attitudes ſhould be ſimple and graceful, the countenance always pleaſing, though varied and ſtrongly marked agreeable to the nature of the object repreſented.

The Caryatides, or female figures, ſhould never much exceed the human ſize. But the Perſians, or male figures, may be of any ſize; and the larger the better, as they will ſtrike the beholder with the greater awe and aſtoniſhment. Perſians may be uſed with propriety in arſenals, galleries of armour, *&c.* under the figures of captives, heroic virtues, *&c.* Their entablature ought to be Doric, and bear the ſame proportion to them as to columns of the ſame height. The entablature for Caryatides ought to be either Ionic or Corinthian, according as the character of the figures is more or leſs delicate.

Termini are ſometimes employed, inſtead of Perſians or Caryatides, to ſupport the entablatures of monuments, chimney-pieces, and ſuch like compoſitions. Theſe figures owe their origin to the ſtones uſed by the ancients to mark the limits of particular poſſeſſions. Numa Pompilius, to render theſe inviolable, conſecrated the terminus into a deity, and inſtituted feſtivals and ſacrifices to his honour. In a ſhort time, what was formerly only large upright ſtones, were repreſented in human ſhape; and afterwards introduced as ornaments to temples and other buildings. The termini are now principally uſed as ornaments for gardens and fields.

OF PEDESTALS.

MOST writers conſider the PEDESTAL as a neceſſary part of the order; without which it is not complete. It is indeed a matter of little importance whether it be conſidered in that light, or as a diſtinct compoſition: We ſhall therefore treat of a pedeſtal as a diſtinct body, having no more connection with the order than an Attic, a baſement, or any other part with which it may on ſome occaſions be aſſociated.

A pedeſtal conſiſts of three principal parts; the baſe, the dye, and the cornice. The dye is always nearly of the ſame figure; being conſtantly either a cube or a parallelopipedon: But the baſe and cornice are varied and adorned with more or fewer mouldings, according to the ſimplicity or richneſs of the compoſition in which the pedeſtal is employed. Hence pedeſtals are, like columns, diſtinguiſhed by the names of Tuſcan, Doric, Ionic, Corinthian, and Compoſite.

Some authors are averſe to pedeſtals, and compare a column raiſed on a pedeſtal to a man mounted on ſtilts; imagining that they were introduced merely from neceſſity, and for want of columns of a ſufficient length. It is indeed true, that the ancients often made uſe of artifices to lengthen their columns; as appears by ſome that are in the Baptiſtery of Conſtantine at Rome; the ſhafts of which being too ſhort for the building, were lengthened and joined to their baſes by an undulated ſweep, adorned with acanthus leaves. Nevertheleſs, there are many occaſions where pedeſtals are evidently neceſſary; and ſome in which the order, were it not ſo raiſed, would

lofe much of its beautiful appearance. Thus, in the infides of churches, if the columns that fupport the vault were placed immediately on the ground, the feats would hide their bafes, and a good part of their fhafts; and, in the theatres of the ancients, if the columns of the fcene had been placed immediately on the ftage, the actors would have hid a part of them from the audience. In interior decorations, a pedeftal diminifhes the parts of the order, which otherwife might perhaps appear too clumfy, and hath the advantage of placing the column in a more favourable view, by raifing its bafe nearer the level of the fpectator's eye. In a fecond order of arcades, there is no avoiding pedeftals; as without them it is impoffible to gives the arches any tolerable proportion.

With regard to the proportion that pedeftals ought to bear to that of the columns they fupport, it is by no means fixed. Both the ancients and moderns vary greatly on this head. Vignola's proportions are generally reckoned the beft. He makes his pedeftals, in all the orders, of the fame height, *viz.* one third of the column; and as their breadth of courfe increafes or diminifhes in the fame degree as the diameters of their refpective columns do, the character of the order is always preferved, which, according to any other method, is impoffible.

As to the divifions of the pedeftal; if the whole height be divided into nine parts, one of them may be given to the height of the cornice, two to the bafe, and the fix remaining to the dye. The breadth of the dye is always made equal to that of the plinth of the column. The projection of the cornice may be made equal to its height; and the bafe being divided into three parts, two of them will be for the height of the plinth, and one for the mouldings, whofe projection muft be lefs than that of the cornice. Thefe meafures are common to all pedeftals. See Plate XXX.

OF INTERCOLUMNIATIONS.

Columns are either engaged, or infulated; and, when infulated, are either very near the wall, or at a confiderable diftance from it. Engaged columns, or fuch as are near the walls of a building, are not limited in their intercolumniations, as thefe depend on the breadths of the arches, windows, niches, or other decorations placed between the columns. But columns that are entirely detached, and perform alone the office of fupporting the entablature, as in periftyles, porches, and galleries, muft be near each other, for the fake both of real and apparent folidity.

The intercolumniations among the ancients were various. Thofe ufed in the Ionic and Corinthian orders were the pycnoftyle, of which the interval was equal to one diameter and a half of the column; the fyftyle, whofe interval was equal to two diameters; the euftyle, to two and a quarter; the diaftyle to three, and the aræoftyle to four. In the Doric order, they ufed other intercolumniations, regulating them by the triglyphs, one of which was always placed directly over the middle of each column; fo that they were either fyftyle, monotriglyph, of one diameter and a half; diaftyle, of two diameters and three quarters; or aræoftyle, of four diameters; and the Tufcan intervals were very wide, fome of them being above feven diameters, which was very practicable, as the architraves were of wood.

Among thefe different intercolumniations, the pycnoftyle and fyftyle are too narrow; for although the ancients made frequent ufe of them, that ought rather to be afcribed to neceffity than choice. For, as the architraves were compofed of fingle ftones, extending from the middle of one column to the middle of another, it would have been difficult, efpecially in large buildings, to find blocks of a fufficient length for diaftyle intervals. With regard to the aræoftyle and Tufcan intercolumniations, they are by much too wide, and can only be ufed in ruftic buildings, where the architraves are of wood; neither is the diaftyle fufficiently folid in large compofitions. The euftyle is a medium between the narrow and broad intervals; and, being at the fame time both fpacious and folid, hath been preferred to any of the reft by the ancients as well as the moderns.

Vignola obferved nearly the fame proportion in all his intercolumniations; which practice, though condemned by feveral writers, is certainly preferable to any other; as it preferves the character of each order, and maintains in all of them an equal degree of real folidity. Setting afide therefore the pycnoftyle and fyftyle difpofitions on account of their want of fpace, and the aræoftyle for its deficiency in point of ftrength, it may be eftablifhed, that the diaftyle and euftyle intercolumniations, (the latter of which, on moft occafions, ought to have the preference), may be employed in all the orders without diftinction, excepting the Doric; in which the moft perfect interval is ditriglyph; neither the monotriglyph, nor the aræoftyle, being to be fuffered but in cafes of neceffity.

Sometimes, on account of the windows, doors, niches, and other decorations, which correfpond with the intercolumniations of the periftyle, or gallery, it is not poffible to make the intervals fo narrow as euftyle, or even as diaftyle: Wherefore the moderns, authorifed by fome few examples of the ancients, where grouped columns are employed, have invented a manner of difpofing them, called by Perrault *aræoftyle*, which admits of a larger interval, without any detriment to the apparent folidity of the building. This kind of difpofition is compofed of two fyftyle intercolumniations; the column that feparates them being approached towards one of thofe at the extremities, fufficient room only being left between them for the projection of the capitals; fo that the great fpace is three diameters and a half wide, and the little one half a diameter.

In periftyles, galleries, or porticos, all the intercolumniations muft be equal: But in a logio, or porch, the middle interval may be broader than the others, by a triglyph or modilion, or three or four dentils; unlefs the columns at the angles be coupled, or grouped with pilafters; in which cafe, all the intervals fhould be of the fame dimenfions.

When buildings are very fmall, as is frequently the cafe in temples and other inventions ufed for ornamenting gardens, the intercolumniations may be broader, in proportion to the diameter of the columns, than ufual; becaufe,

caufe, when they are nearer each other than three feet, there is hardly room for a bulky perfon to pafs between them.

OF ARCHES.

Arches are not fo magnificent as colonnades; but they are more folid, and lefs expenfive. They are proper for triumphal entrances, gates of cities, of palaces, of gardens, and of parks; and, in general, for all openings that require an extraordinary breadth.

There are various manners of adorning arches. Sometimes their piers are rufticated; fometimes they are adorned with pilafters, termini, or caryatides; and fometimes they are made fufficiently broad to admit niches, or windows. The circular part of the arch is either furrounded with ruftic key-ftones, or with an archivolt enriched with mouldings; which, in the middle, is fometimes interrupted by a confole, a mafk, ferving at the fame time as a key to the arch, and as a fupport to the architrave of the order. The archivolt is fometimes fupported by an impoft, at the head of the pier; and, at others, by columns placed on each fide of it, with a regular entablature, or architrave cornice. There are likewife inftances of arcades without piers, the arches being turned on fingle columns, as in the temple of Faunus at Rome, *&c.* This practice, however, ought to be feldom imitated, as it is neither folid nor handfome.

When arches are large, the key-ftone fhould never be omitted, but cut in the form of a confole, and carried clofe under the foffit of the architrave, which, on account of its extraordinary length, requires a fupport in the middle. The impofts of arches fhould never be omitted; at leaft, if they be, a platform ought to fupply their place. If columns are employed without pedeftals in arcades, they fhould always be raifed on a plinth. In all arches, the circular part ought not to fpring immediately from the impoft, but take its rife at fuch a diftance above it, as is neceffary in order to have the whole curve feen at the proper point of view.

The void or aperture of arches fhould never be higher, nor much lower, than double their breadth; the breadth of the pier fhould feldom exceed two thirds, nor be lefs than one third, of the breadth of the arch; and the angular pier ought to be broader than the others, by one half, one third, or one fourth; the impoft fhould not be more than one feventh, nor lefs than one ninth of the aperture; and the archivolt muft not be more than one eighth, nor lefs than one tenth of it. The breadth of the confole muft, at the bottom, be equal to that of the archivolt; and its fides muft be drawn from the centre of the arch: The length of it muft not be lefs than one and a half of its fmalleft breadth, nor more than double. The thicknefs of the pier depends on the breadth of the portico; for it muft be ftrong enough to refift the preffure of its vault. But, with regard to the beauty of the building, it fhould not be lefs than one quarter of the breadth of the arch, nor more than one third. Thefe are the general dimenfions of arches.

OF ORDERS ABOVE ORDERS.

When, in a building, two or more orders are employed, one above another, the laws of folidity require, the ftrongeft fhould be placed lowermoft. Hence the Tufcan muft fupport the Doric, the Doric the Ionic, the Ionic the Compofite or Corinthian, and the Compofite the Corinthian.

This rule, however, is not always ftrictly adhered to. Moft authors place the Compofite above the Corinthian. There are likewife examples where the fame order is repeated, as in the theatre of Statilius Taurus, and the Colifeum; and others, where an intermediate order is omitted, and the Ionic placed on the Tufcan, or the Corinthian on the Doric. But none of thefe practices ought to be imitated.

In placing columns above one another, the axis of all the columns ought to correfpond, or be in the fame perpendicular line, at leaft in front.

With regard to the proportions of columns placed above each other, Scamozzi's rule, That the lower diameter of the fuperior column fhould conftantly be equal to the upper diameter of the inferior one, is univerfally efteemed the beft, and gives all the columns the appearance of one long tapering tree, cut into feveral pieces. According to this rule, the Doric column will be to the Tufcan, as $13\frac{1}{7}$ to 14; the Ionic to the Doric, as 15 to 16; the Compofite or Corinthian to the Ionic, as $16\frac{2}{3}$ to 18; and the Corinthian to the Compofite, as $16\frac{2}{3}$ to 20.

In Britain there are few examples of more than two ftories of columns in the fame afpect: And, though in Italy, and other parts of Europe, we frequently meet with three, and fometimes more; yet it is a practice by no means to be imitated; for there is no poffibility of avoiding many ftriking inconfiftencies, or of preferving the character of each order in its intercolumnial decorations.

OF BASEMENTS AND ATTICS.

Instead of employing feveral orders one above the other in a compofition, the ground-floor is fometimes made in the form of a *bafement*, on which the order that decorates the principal ftory is placed. The proportion of thefe bafements is not fixed, but depends on the nature of the rooms on the ground-floor. In the palace of the Porti in Vicenza, the height of the bafement is equal to that of the order. In fome buildings, its height exceeds two thirds of that of the order; and in others only half the height of the order. It is not, however, advifeable to make the bafement higher than the order it fupports; neither fhould it be lower than one half of the order.

The ufual method of decorating bafements is with ruftics of different kinds. The beft, where neatnefs and finifhing is aimed at, are fuch as have a fmooth furface. Their height, including the joint, fhould never be lefs, nor much more, than half a module of the order placed on the bafement. Their figure may be from a fquare to a fefquialtera; and their joints may be either fquare or chamfered. The fquare ones fhould not be broader than one eighth of the height of the ruftic, nor narrower than one tenth; and their depth muft be equal to their breadth; thofe that are chamfered, muft form a rectangle; and the breadth

breadth of the whole joint may be from one fourth to one third of the height of the flat ſurface of the ruſtic.

Inſtead of a ſecond order, it is ſometimes uſual to crown the firſt with an Attic Story: Theſe Attics ſhould never exceed in height one third of the height of the order on which they are placed, nor be leſs than one quarter of it. Their figure is that of a pedeſtal: The baſe, dye, and cornice, of which they are compoſed, may bear the ſame proportions to each other as thoſe of pedeſtals do; and the baſe and cornice may be compoſed of the ſame mouldings as thoſe of pedeſtals. Sometimes the Attic is continued throughout; at others, it projects, and forms a pilaſter over each column of the order. The breadth of this pilaſter is ſeldom made narrower than the upper diameter of the column below it, and never broader. Its projection may be equal to one quarter of its breadth.

OF PEDIMENTS.

Pediments moſt probably owe their origin to the inclined roofs of the primitive huts. Among the Romans, they were uſed only as coverings to their ſacred buildings, till Cæſar obtained leave to cover his houſe with a pointed roof, after the manner of temples. In the remains of antiquity we meet with two kinds of pediments, the triangular and circular. The former of theſe are promiſcuouſly applied to cover ſmall or large bodies: But the latter being of a heavier figure, are never uſed but as coverings to doors, niches, windows, or gates.

As a pediment repreſents the roof, it ſhould never be employed but as a finiſhing to the whole compoſition.

The ancients introduced but few pediments into their buildings, uſually contenting themſelves with a ſingle one to adorn the middle or principal part. But ſome of the moderns, and particularly the Italians, have been ſo immoderately fond of them, that their buildings frequently conſiſt of almoſt nothing elſe.

The girder being a neceſſary part in the conſtruction of a roof, it is an impropriety to intermit the horizontal entablature of a pediment, by which it is repreſented, to make room for a niche, an arch, or a window.

In regular architecture, no other form of pediments can be admitted, beſides the triangular and circular. Both of them are beautiful: and when a conſiderable number of pediments are introduced, as when a range of windows are adorned with them, theſe two figures may be uſed alternately, as in the niches of the Panthæon, and in thoſe of the temple of Diana at Niſmes.

The proportion of pediments depends upon their ſize; for the ſame proportions will not do in all caſes. When the baſe of the pediment is ſhort, its height muſt be increaſed; and when the pediment is long, the height muſt be diminiſhed The beſt proportion for the height is from one fifth to one fourth of the baſe, according to the extent of the pediment, and the character of the body it covers. The materials of the roof muſt alſo be attended to; for if it be covered with tyles, it will be neceſſary to raiſe it more than one quarter of the baſe, as was the cuſtom of the ancients in their Tuſcan temples.

The tympan is always on a line with the front of the frize; and, when large, admits of various ornaments.

OF BALLUSTRADES.

Ballustrades are ſometimes of real uſe in buildings; and at other times they are only ornamental. Such as are intended for uſe, as when they are employed in ſtair-caſes, before windows, or to incloſe terraſſes, *&c.* muſt always be nearly of the ſame height; never exceeding three feet and a half, nor ever leſs than three. But thoſe that are principally deſigned for ornament, as when they finiſh a building, ſhould be proportioned to the architecture they accompany; and their height ought never to exceed four fifths of the height of the entablature on which they are placed; nor ſhould it ever be leſs than two thirds thereof, without counting the zocholo, or plinth, the height of which muſt be ſufficient to leave the whole balluſtrade expoſed to view.

The beſt proportion for balluſtrades is to divide the whole given height into thirteen equal parts; eight of theſe for the height of the balluſter, three for the baſe, and two for the cornice or rail; or into fourteen, (if it be required to make the balluſter leſs), giving eight parts to the balluſter, four to the baſe, and two to the rail. One of theſe parts may be called a module; and, being divided into nine minutes, may ſerve to determine the dimenſions of the particular members.

In balluſtrades, the diſtance between two balluſters ſhould not exceed half the diameter of the balluſter meaſured in its thickeſt part, nor be leſs than one third of it.

The breadth of the pedeſtals, when they are placed on columns or pilaſters, is regulated by them; the dye never being made broader than the top of the ſhaft, nor much narrower: and when there are neither columns nor pilaſters in the front, the dye ſhould not be much lower than a ſquare, and ſeldom higher. On ſtairs, or any other inclined planes, the ſame proportions are to be obſerved as on horizontal ones.

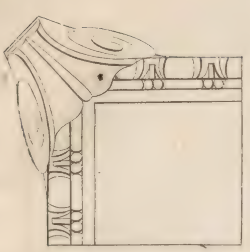
OF GATES, DOORS, AND PIERS.

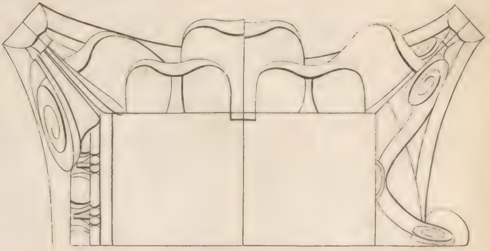
There are two kinds of entrances, *viz.* doors and gates. The former ſerve only for the paſſage of perſons on foot; but the latter likewiſe admit horſemen and carriages. Doors are uſed as entrances to churches, and other public buildings, to common dwelling-houſes, and apartments: And gates ſerve for inlets to cities, fortreſſes, parks, gardens, palaces, *&c.* The apertures of gates being always wide, they are generally made in the form of an arch, that figure being the ſtrongeſt. But doors, which are generally of ſmall dimenſions, are commonly parallelograms, and cloſed horizontally.

The general proportion for the apertures, both of gates and doors, whether arched or ſquare, is, that the height be about double the breadth.

The uſual ornaments of gates conſiſt of columns, pilaſters, entablatures, pediments, ruſtics of different kinds, impoſts, archivolts, *&c.*; and the moſt common method of adorning doors is with an architrave, for rounding the

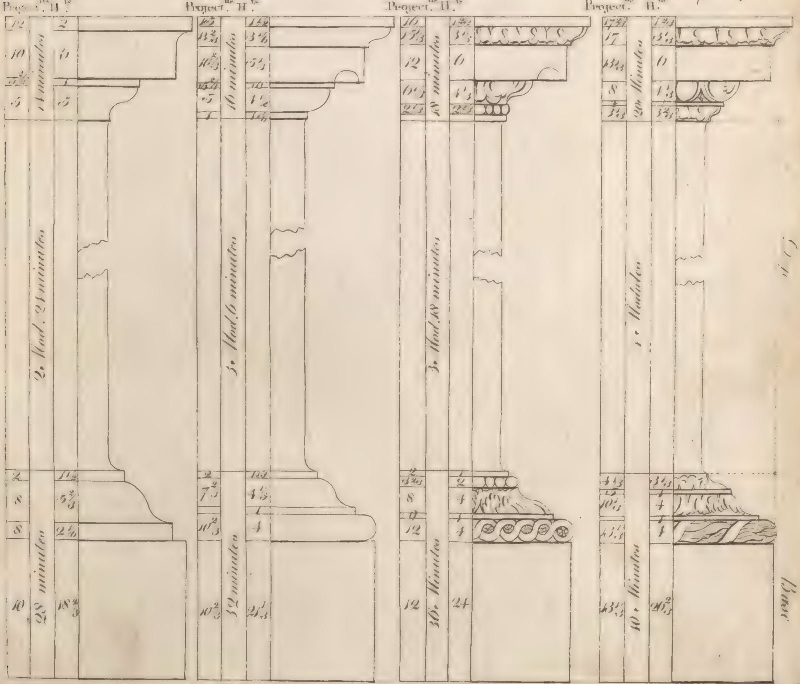
Plans of Pilaster Capitals





Pedestals

Tuscan — Doric — Ionic — Corinthian & Comp.ᵗᵉ



I. Bell sculp.

Fig. 1.

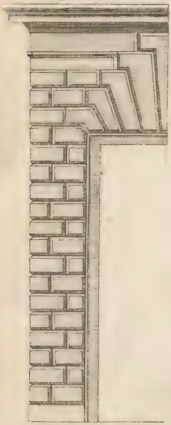


Fig. 2.

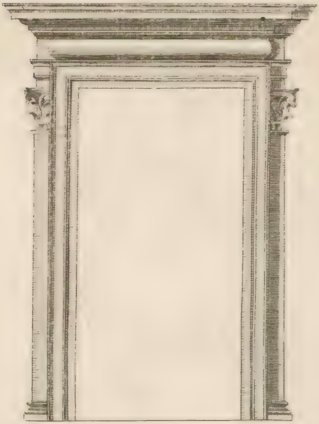


Fig. 3.

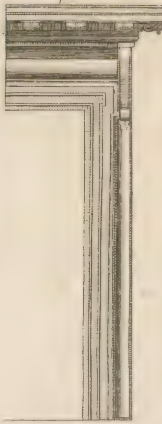


Fig. 4.

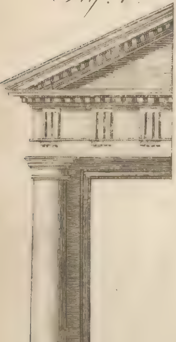
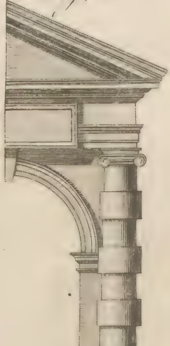


Fig. 5.

Fig. 6.



A. Bell Sculp.

Plate XXXII.

Fig. 1.

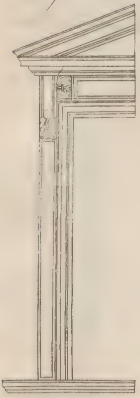


Fig. 2.

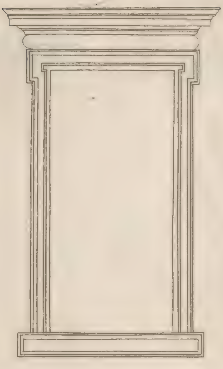


Fig. 3.

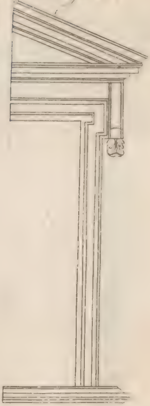


Fig. 4.

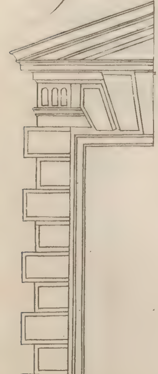


Fig. 5.

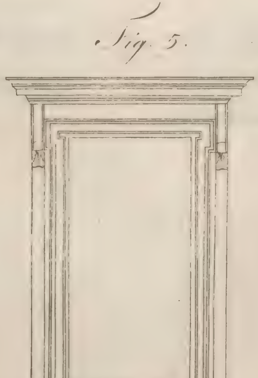


Fig. 6.

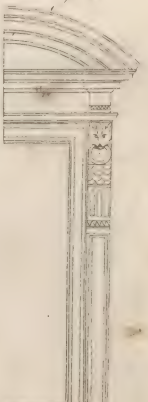


Plate XXXIII.

Fig. 1.

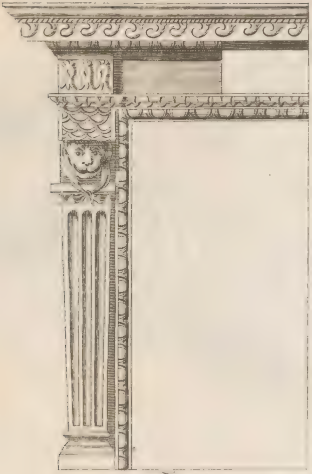


Fig. 2.

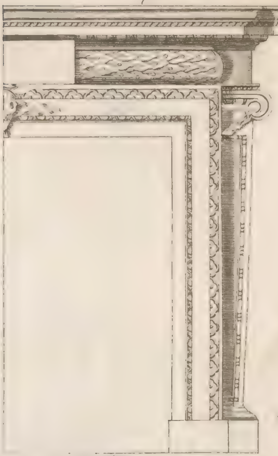
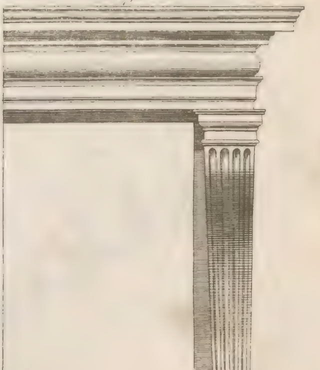


Fig. 3.

Fig. 4.



A. Bell Sculp.t

Plate XXXIV.

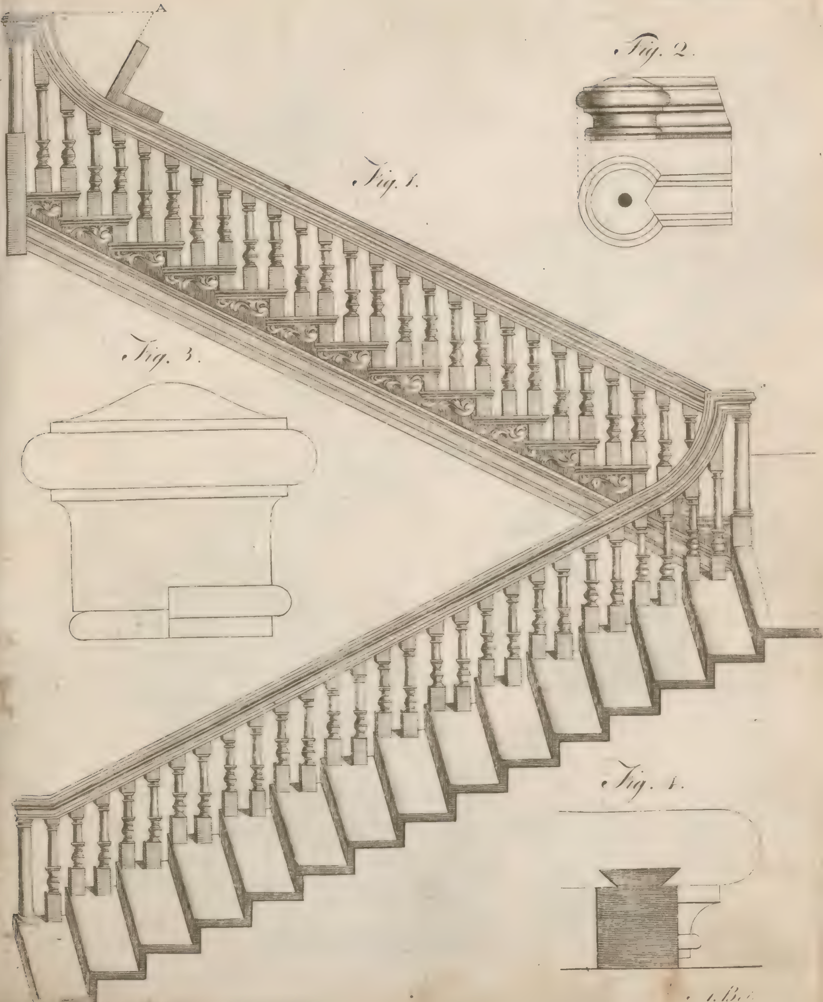


Plate XXXV

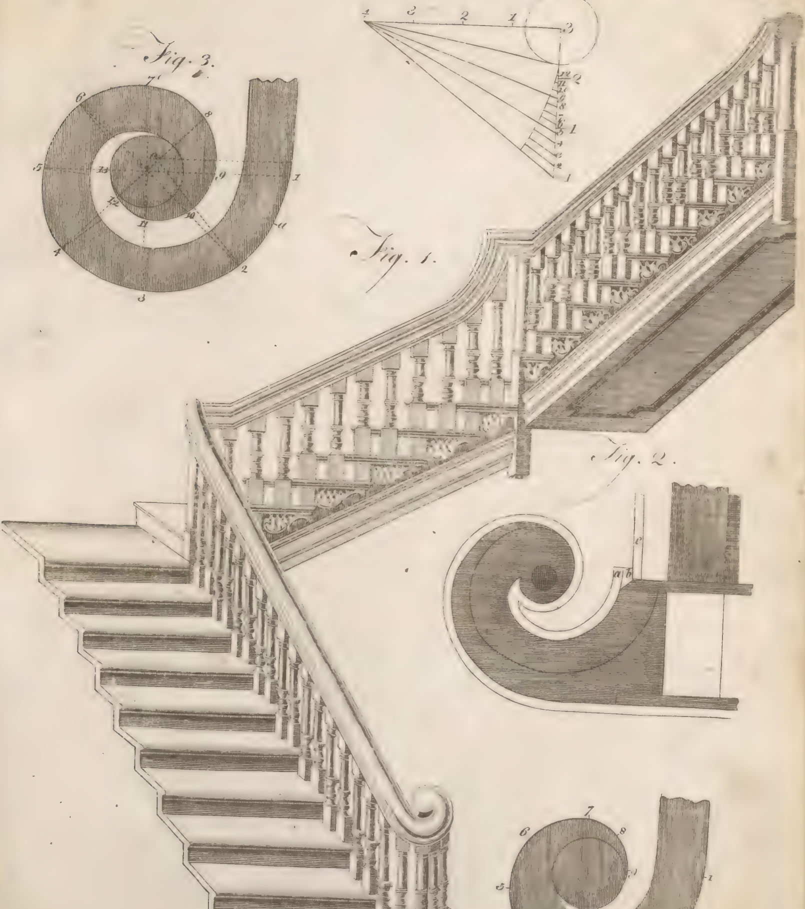
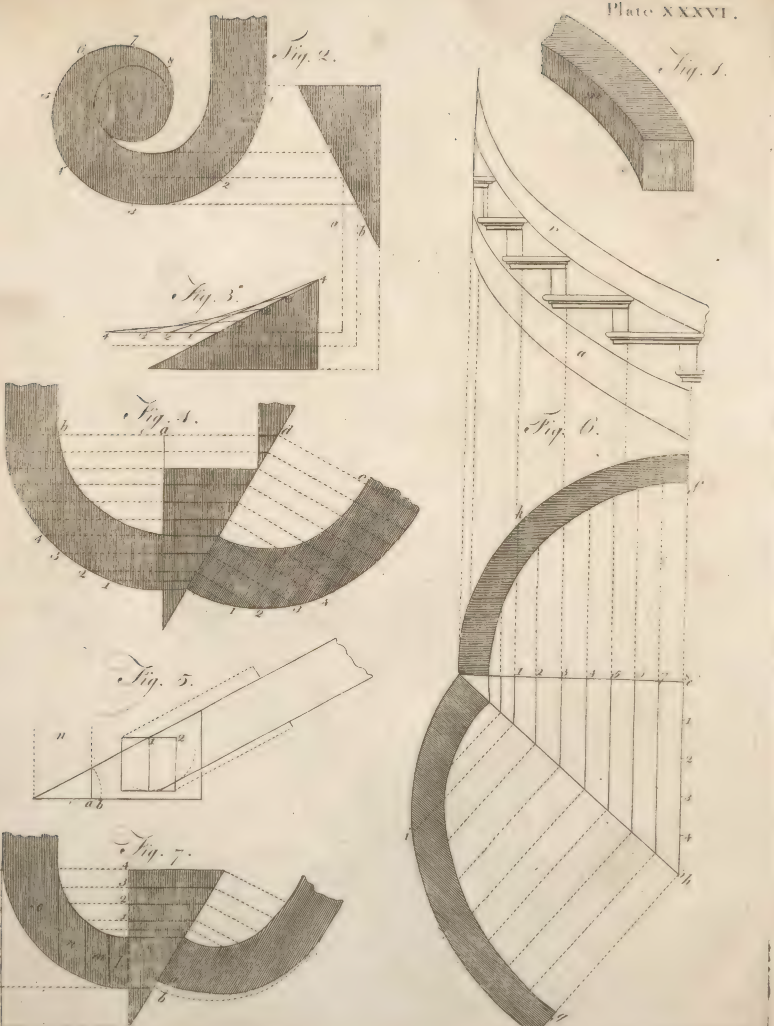


Fig. 1. Fig. 2. Fig. 3. Fig. 4.

A. B. sc.

Plate XXXVI.



A. Bell Sculpt.

Plate XXXVII.

Fig. 1.

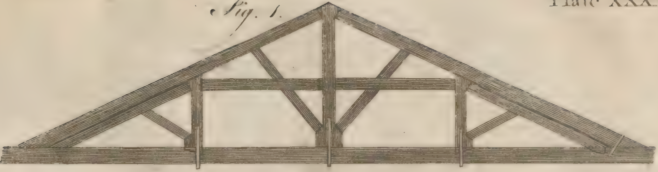


Fig. 2.

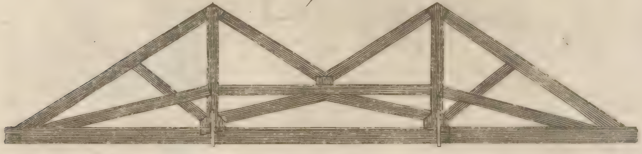


Fig. 3.

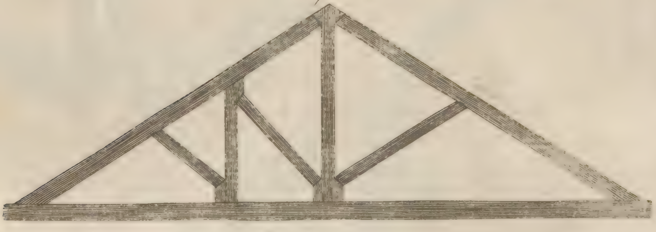
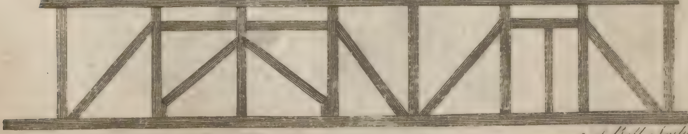


Fig. 4.

Fig. 5.

Fig. 6.



A. Bell Sculp.

the ſides and top of the aperture, on which are placed a regular frize and cornice. Sometimes the cornice is ſupported by a couple of conſoles placed on each ſide of the door; and ſometimes, beſides an architrave, the aperture is adorned with columns, pilaſters, caryatides, or termini; and a regular entablature with a pediment.

Inſide-doors, however ſmall the building may be, ſhould never be narrower than two feet nine inches; nor ſhould they ever, in private houſes, exceed three feet ſix inches in breadth, which is more than ſufficient to admit the bulkieſt perſon. Their height ſhould at leaſt be ſix feet three or four inches; otherwiſe a tall perſon cannot paſs without ſtooping. In churches, palaces, *&c.* where there is a conſtant ingreſs and egreſs of people, the apertures muſt be larger. The ſmalleſt breadth that can be given to a gate is $8\frac{1}{2}$ or 9 feet, which is but juſt ſufficient for the paſſage of a coach.

Plate XXXI. Fig. 1. Is a ruſtic door, compoſed by the celebrated Vignola, in which the aperture occupies two thirds of the whole height, and one half of the whole breadth; the figure of it being a double ſquare. The ruſtics may be either ſmooth or hatched; their joints muſt form a rectangle, and the breadth of each joint may be one third, or two ſevenths, of the vertical ſurface of a ruſtic. The joints of the claveaux, or key-ſtones, muſt be drawn to the ſummit of an equilateral triangle, whoſe baſe is the top of the aperture. The architrave ſurrounding the aperture may be compoſed either of a large ogee and fillet, or of a plat-band and fillet. Its whole breadth muſt be one tenth of the breadth of the aperture; the remaining part of each pier being for the ruſtics. The entablature is Tuſcan: The cornice is to be one fifteenth of the whole height of the door; and what remains below it being divided into twenty-one equal parts, the two uppermoſt of them will be for the frize and architrave, and the remaining nineteen for the ruſtics and plinth at the foot of the door.

Fig. 2. Is a diſpoſition of Michael Angelo's. The windows of the Capitol at Rome are of this kind; and Sir Chriſtopher Wren hath executed doors of the ſame kind under the ſemicircular porches in the flanks of St Paul's. The figure of the aperture may be a double ſquare; the architrave one ſixth of the breadth of the aperture; and the whole entablature one quarter of its height. The front of the pilaſters or columns, on each ſide, muſt be on a line with the faſcia of the architrave; and their breadth muſt be a ſemidiameter.

Fig. 3. Is likewiſe a deſign of Vignola's. It is of the Corinthian order, and executed in the Cancellaria at Rome. The height is equal to double its breadth; and the whole ornament at the top is equal to one third of the height of the aperture. The architrave is in breadth one fifth of the breadth of the aperture; and the pilaſters that ſupport the conſoles, are half as broad as the architrave. The whole is well imagined, but rather heavy; and it will be beſt to reduce the architrave to one ſixth of the aperture, diminiſhing the entablature proportionally.

Fig. 4. Is a deſign of Serlio's. The aperture may be either twice as high as broad, or a trifle leſs. The diameter of the columns may be equal to one quarter of the breadth of the aperture; and their height may be from eight diameters to eight and a half. The entablature muſt be ſomewhat leſs than one quarter of the height of the columns; and the height of the pediment may be one quarter of its baſe.

Fig. 5. Is a door in the ſalon of the Farneſe at Rome, deſigned by Vignola. The aperture forms a double ſquare. The entablature is equal to three elevenths of its height, the architrave being one of theſe elevenths; and the whole ornament on the ſides, conſiſting of the architrave and pilaſters, is equal to two ſevenths of the breadth of the aperture: The cornice is Compoſite, enriched with mutules and dentils; and the frize is adorned with a feſtoon of laurel.

Fig. 6. Is copied from a door at Florence, ſaid to be a deſign of Cigoli's. The height of the aperture is a trifle more than twice its breadth. It is arched; and the impoſt is equal to half a diameter. The columns are Ionic, ſomewhat above nine diameters high; and their ſhafts are garniſhed each with five ruſtic cinctures. The entablature is leſs than one quarter of the column; and the breadth of the tablet, in which there is an inſcription, is equal to the breadth of the aperture.

OF WINDOWS.

The firſt conſideration with regard to windows, is their ſize, which varies according to the climate, the deſtination of the building, *&c.* In Britain, the windows of the ſmalleſt private houſes are commonly from 3 to $3\frac{1}{2}$ feet broad; and being generally twice their breadth in height, or ſomewhat more, in the principal apartments, they generally riſe to within a foot or two of the ceilings of the rooms, which are frequently no higher than 10 feet, and at moſt 12 or 13. But, in more conſiderable houſes, the apartments are from 15 to 20 feet high, and ſometimes more; and in theſe the windows are from 4 to 5 and $5\frac{1}{2}$ feet broad, and high in proportion. Theſe dimenſions are ſufficient for dwelling-houſes of any ſize in this country; when they are larger, they admit too much of the cold air in winter. But churches, and other buildings of that kind, may have larger windows, proportioned to the ſize of the ſtructures.

The proportions of the apertures of windows depend upon their ſituation. Their breadth in all the ſtories muſt be the ſame; but the different heights of the apartments make it neceſſary to vary the height of the windows likewiſe. In the principal floor, it may be from $2\frac{1}{5}$ of the breadth to $2\frac{1}{3}$, according as the rooms have more or leſs elevation. In the ground-ſtory, where the apartments are lower, the apertures of the windows ſeldom exceed a double ſquare; and, when they are in a ruſtic baſement, they are frequently made much lower. The height of the windows of the ſecond floor may be from $1\frac{1}{2}$ of their breadth to $1\frac{4}{5}$; and Attics and Mezzanines may be either a perfect ſquare, or ſomewhat lower.

The windows of the principal floor are generally moſt enriched. The ſimpleſt method of adorning them is, with an architrave ſurrounding the aperture, and crowned with a frize and cornice. The windows of the ground-floor are ſometimes left entirely plain, without any

any ornament; and at others they are ſurrounded with ruſtics, or a regular architrave with a frize and cornice. Thoſe of the ſecond floor have generally an architrave carried entirely round the aperture; and the ſame is the method of adorning Attic and Mezzanine windows: But the two laſt have ſeldom either frize or cornice; whereas the ſecond-floor windows are often crowned with both.

The breaſts of all the windows on the ſame floor ſhould be on the ſame level, and raiſed above the floor from two feet nine inches to three feet ſix inches at the very moſt. When the walls are thick, the breaſts ſhould be reduced under the apertures, for the conveniency of looking out. In France, the windows are frequently carried quite down to the floor. When the building is ſurrounded with gardens, or other beautiful objects, this method renders the rooms exceeding pleaſant.

The interval between the apertures of windows depends in a great meaſure on their enrichments. The breadth of the aperture is the leaſt diſtance that can be between them; and twice that breadth ſhould be the largeſt in dwelling-houſes; otherwiſe the rooms will not be ſufficiently lighted. The windows in all the ſtories of the ſame aſpect muſt be placed exactly above one another.

Plate XXXII. Fig. 1. Is a deſign of P. Leſcot, abbot of Clagny, executed in the old Louvre at Paris. The apertures may be a double ſquare, or a trifle more; the architrave from one ſixth to one ſeventh of the beadth of the aperture: The pilaſter is equal to that breadth, when the architrave is narrow; or leſs, by one quarter, or one fifth, when it is broad. The whole entablature ſhould not exceed one quarter of the height of the aperture, nor be much lower. The conſoles may be equal in length to half the breadth of the aperture at moſt, and to one third of it at leaſt.

Fig. 2. Is a deſign of Palladio's, executed at the Chiericato in Vincenza: Its proportions are not much different from the following. The plat-band that ſupports the window is equal to the breadth of the architrave.

Fig. 3. Is likewiſe a deſign of Palladio's, executed by him in many of his buildings. The aperture is a double ſquare. The breadth of the architrave is one ſixth of the breadth of the aperture; and the frize and cornice together are double the height of the architrave. The breadth of the conſoles is two thirds of the breadth of the architrave.

Fig. 4. Is a deſign of Ludovico Da Cigoli; and executed in the ground-floor of the Ranunchini palace at Florence.

Fig. 5. Is a deſign of Inigo Jones, executed at the Banqueting-houſe. The aperture may be a double ſquare; the architrave may be one ſixth of its breadth; the whole entablature one quarter of its height; and the breadth of the conſoles two thirds of the breadth of the architrave.

Fig. 6. Is a deſign of M. Angelo Buonaroti, executed at the Farneſe.

OF NICHES AND STATUES.

It hath been cuſtomary, in all ages, to enrich different parts of buildings with repreſentations of the human body. Thus the ancients adorned their temples, baths, theatres, &c. with ſtatues of their deities, heroes, and legiſlators. The moderns ſtill preſerve the ſame cuſtom, placing in their churches, palaces, &c. ſtatues of illuſtrious perſons, and even groups compoſed of various figures, repreſenting occurrences collected from hiſtory, fables, &c. Sometimes theſe ſtatues or groups are detached, raiſed on pedeſtals, and placed contiguous to the walls of a building, or in the middle of a room, court, or public ſquare. But they are moſt frequently placed in cavities made in the walls, called *niches*. Of theſe there are two ſorts; the one formed like an arch in its elevation, and ſemicircular or ſemielliptical in its plan; the other is a parallelogram both in its plan and elevation.

The proportion of both theſe niches depends on the character of the ſtatues, or the general form of the groups placed in them. The loweſt are at leaſt a double ſquare in height; and the higheſt never exceed $2\frac{1}{2}$ of their breadth.

With regard to the manner of decorating them, when they are alone in a compoſition, they are generally incloſed in a pannel, formed and proportioned like the aperture of a window, and adorned in the ſame manner. In this caſe, the niche is carried quite down to the bottom; but on the ſides and at the top, a ſmall ſpace is left between the niche and the architrave of the pannel. And when niches are intermixed with windows, they may be adorned in the ſame manner with the windows, provided the ornaments be of the ſame figure and dimenſions with thoſe of the windows.

The ſize of the ſtatues depends on the dimenſions of the niches. They ſhould neither be ſo large as to have the appearance of being rammed into the niches, as in Santa Maria Majore at Rome; nor ſo narrow as to ſeem loſt in them, as in the Panthæon. The diſtance between the outline of the ſtatue and ſide of the niche ſhould never be leſs than one third of a head, nor more than one half, whether the niche be ſquare or arched; and when it is ſquare, the diſtance from the top of the head to the ceiling of the niche ſhould not be greater than the diſtance on the ſides. Statues are generally raiſed on a plinth, the height of which may be from one third to one half of a head; and ſometimes, where the niches are large, the ſtatues may be raiſed on ſmall pedeſtals.

The character of the ſtatue ſhould always correſpond with the character of the architecture with which it is ſurrounded. Thus, if the order be Doric, Hercules, Jupiter, Mars, Æſculapius, and all male ſtatues repreſenting beings of a robuſt and grave nature, may be introduced; if Ionic, then Apollo, Bacchus, &c.; and if Corinthian, Venus, Flora, and others of a delicate nature, ſhould be employed.

OF CHIMNEY-PIECES.

Among the ancients, there are very few examples of chimney-pieces to be met with. Neither the Italians nor French have excelled in compoſitions of this kind. Britain, by being poſſeſſed of many able ſculptors at different

different times, has surpassed all other nations, both in taste of design, and workmanship.

The size of the chimney must be regulated by the dimensions of the room where it is placed. In the smallest apartments, the breadth of the aperture should never be less than three feet, to three feet six inches. In rooms from 20 to 24 feet square, or of equal superficial dimensions, it may be from 4 to $4\frac{1}{2}$ feet broad; in those of 24 to 27, from $4\frac{1}{2}$ to 5; and, in such as exceed these dimensions, the aperture may even be extended to $5\frac{1}{2}$ or 6 feet.

The chimney should always be situate so as to be immediately seen by those who enter the room. The middle of the partition wall is the most proper place in halls, salons, and other rooms of passage; but in drawing-rooms, dressing-rooms, and the like, the middle of the back wall is the best situation. In bed-rooms, the chimney is always in the middle of one of the partition-walls; and in closets, and other very small places, to save room, it is put in a corner. Where-ever two chimneys are used in the same room, they should be placed either directly facing each other, if in different walls, or at equal distances from the centre of the wall in which they both are.

The proportion of the apertures of chimney-pieces of a moderate size is generally a perfect square; in small ones, it is a trifle higher; and in large ones, a trifle lower. Their ornaments consist in architraves, frizes, cornices, columns, pilasters, termini, caryatides, consoles, and all kinds of ornaments of sculpture, representing animals and vegetables, *&c.* likewise vases, chalices, trophies of arms, *&c.* In designing them, regard must be had to the nature of the place where they are to be employed. Such as are intended for halls, salons, guard-rooms, galleries, and other large places, must be composed of large parts, few in number, of distinct and simple forms, and having a bold relief; but chimney-pieces for drawing-rooms, dressing-rooms, *&c.* may be of a more delicate and complicated nature.

Chimney-pieces are composed of wood, stone, or marble; the last of which ought to be preferred, as figures or profiles are best represented in a pure white.

Plate XXXIII. Fig. 1, 2, 3, and 4. are different designs for chimney-pieces by Palladio and Inigo Jones. Their proportion may be gathered from the designs, which are accurately executed.

OF THE PROPORTIONS OF ROOMS.

The proportions of rooms depend in a great measure on their use, and actual dimensions: But, with regard to beauty, all figures, from a square to a sesquialteral, may be emloyed for the plan.

The height of rooms depends on their figure. Flat ceiled ones may be lower than those that are coved. If their plan be a square, their height should not exceed five sixths of the side, nor be less than four fifths; and when it is oblong, their height may be equal to their breadth. But coved rooms, if square, must be as high as broad; and when oblong, they may have their height equal to their breadth, more one fifth, one quarter, or even one third of the difference between the length and breadth: And galleries should at least be in height one and one third of their breadth, and at most one and a half, or one and three fifths.

The coldness the British climate is a strong objection to high rooms; so that it is not uncommon to see the most magnificent apartments not above 15, 16, or at most 18 feet high; though the extent of the rooms would require a much more considerable elevation. But, where beauty is aimed at, this practice ought not to be imitated.

When rooms are adorned with an intire order, the entablature should never exceed one sixth of the whole height in flat-ceiled rooms, and one sixth of the upright part in coved ones; and when there are neither columns nor pilasters, but only an entablature, its height should not be above one seventh of these heights. If the rooms be finished with a simple cornice, it should never exceed one fourteenth, nor ever less than one fifteenth part of the above-mentioned height.

OF CEILINGS.

Ceilings are either flat, or coved, in different manners. The simplest of the flat kind are those adorned with large compartments, surrounded with one or several mouldings, either let into the ceiling, or projecting beyond its surface: And when the mouldings that form the compartments are enriched, and some of the compartments adorned with well-executed ornaments, such ceilings have a good effect, and are very proper for common dwelling-houses, and all low apartments. Their ornaments and mouldings do not require a bold relief; but, being near the eye, they must be finished with taste and neatness. For higher rooms, a flat ceiling which has the appearance of being composed of various joists framed into each other, and forming compartments of various geometrical figures, should be employed. The sides of the joists forming the compartments are generally adorned with mouldings, and represent either a simple architrave, or an architrave-cornice, according to the size of the compartments and the height of the room.

Coved ceilings are more expensive; but they are likewise more beautiful. They are used promiscuously in large and small rooms, and occupy from one fifth to one third of the height of the room. If the room be low in proportion to its breadth, the cove must likewise be low; and when it is high, the cove must be so likewise: By which means the excess of the height will be rendered less perceptible. But, where the architect is at liberty to proportion the height of the room to its superficial dimensions, the most eligible proportion for the cove is one fourth of the whole height. In parallelogram-figured rooms, the middle of the ceiling is generally formed into a large flat pannel. This pannel, with the border that surrounds it, may occupy from one half to three fifths of the breadth of the room. The figure of the cove is commonly either a quadrant of a circle or of an ellipse, taking its rise a little above the cornice, and finishing at the border round the great pannel in the centre. The border projects somewhat beyond the coves on the outside.

fide; and, on the fide towards the pannel, it is generally made of a fufficient depth to admit the ornaments of an architrave, or architrave and cornice.

In Britain, circular rooms are not much in ufe; but they are very beautiful. Their height muft be the fame with that of fquare rooms; their ceilings may be flat; but they are handfomer when coved, or of a concave form.

Arcs doubleaux, or foffits of arches, when narrow, are ornamented with *guillochis*, or frets; but, when broad, they may be adorned in a different manner.

When the profiles of the room are gilt, the ceilings ought likwife to be gilt. The ufual method is to gild all the ornaments, and to leave the grounds white, pearl colour, light blue, or of any other tint proper to fet off the gilding to advantage. Painted ceilings, fo common in France and Italy, are but little ufed in Britain.

OF STAIRS AND STAIR-CASES.

THERE are many kinds of ftair-cafes; for in fome the fteps are made ftraight; in others, winding; in others mixt of both. Of ftraight ftairs, fome fly directly forward; others are fquare; others triangular. Others are called French flights, or winding-ftairs, (which in general are called fpiral or cockle-ftairs); of which fome are fquare; fome circular, or round; and fome elliptical, or oval; and thefe again are various; for fome wind about a folid, others about an open newel. Stairs mixt of ftraight and winding fteps are alfo of various kinds; fome are called dog-legged; fome there are that wind about a folid newel; and others that fly about a fquare open newel.

Great care ought to be taken in placing of the ftaircafe in any building; and therefore ftair-cafes ought to be defcribed, and accounted for juftly, when the plan of a building is made. For want of this, fometimes unpardonable errors have been committed: Such as having a little blind ftair-cafe to a large houfe; or, on the other hand, to have a large fpacious ftair-cafe to a little one.

Palladio fays, in placing ftair-cafes, the utmoft care ought to be taken, it being difficult to find a place convenient for them, that will not at the fame time prejudice the reft of the building. But commonly the ftairs are placed in the angle, wing, or middle of the front.

To every ftair-cafe are required three openings.

Firft, the door leading thereto.

Secondly, the window, or windows, that give light to it;

And, thirdly, the landing.

Firft, the door leading to a ftair-cafe fhould be fo placed, that moft of the building may be feen before you come at the ftairs, and in fuch a manner that it may be eafy for any perfon to find out.

Secondly, for the windows; if there be but one, it muft be placed in the middle of the ftair-cafe, that thereby the whole may be enlightened.

Thirdly, the landing of ftairs fhould be large and fpacious, for the convenient entering into rooms: In a word, ftair-cafes fhould be fpacious, light, and eafy in afcent. The height of large fteps muft never be lefs than fix inches, nor more than feven inches and a half.

The breadth of fteps fhould never be lefs than 10 inches, nor more than 18 inches; and the length of them not lefs than three feet, nor more than 12.

Plate XXXIV. Fig. 1. A ftair-cafe of two flights.—*A* fhews the manner of drawing the *ramp*, which is to rife equal to the height of the firft ftep of the next flight, and as much as its *kneeling*; as is fhewn by the *ramp* interfecting the rail of the fecond flight.

Fig. 2. Shews the ftraight rail interfecting a circular cap.

Fig. 3. Section of two different hand-rails.

Fig. 4. Shews the manner of dove-tailing the rifer into the ftep.

Plate XXXV. Fig. 1. Reprefents a ftair-cafe, with flights, and its landing rail.

Fig. 2. Shews the folid part of the ftep out of which the fcroll is formed; where *a* reprefents the *overfail* of the ftep; *b*, The thicknefs of the bracket, with its *mitring* to the *rifer*; and, *c*, The *ftring-board*.

Fig. 4. Shews the fcale for drawing the fcroll of fig. 3.—To perform which, take the diftance from 1 to the centre, in fig. 3. and fet it from 1 to the centre in fig. 4.; divide that extent into three parts, then fet four fuch parts on the upper fide of the fcale, and draw the line from 4 to 1; fet one foot of your compaffes at 4, and ftrike the circular line; let that be divided into 12 equal parts, and then draw lines from 4 through thofe divifions to the upright line.

The fcale being thus made, draw the fcroll of fig. 3. by it in the following manner.

Set one foot of your compaffes in 1, and defcribe a ftroke at *c*; take the fame diftance, and with one foot in 2, crofs the ftroke at *c*; then from *c*, turn the part from 1 to 2, and proceed in the fame manner; for if the diftance were taken in the fcale from 1 to the centre, it would ftrike the circle too flat; and if taken from 2, it would ftrike the circle too quick.

When this is well underftood, there will be little difficulty in drawing the fcroll below fig. 2.; which throws itfelf out farther in proportion than that in fig. 3.; for this will always be the cafe when the upper line of the fcale, which confifts of four divifions in fig. 4. is made but with three divifions or lefs; whence it appears, that the upper line of the fcale may be drawn at what length you pleafe, according as you would bring in or keep out the fcroll.

Plate XXXVI. Shews the manner of fquaring twiftrails.

Fig. 2. Exhibits the pitch-board, to fhew what part of the ftep the twifted part of the rail contains; the three doted lines drawn from the rail to the pitch-board reprefent the width of the rail, which is to be kept level. The doted lines *a* and *b* fhew how much half the width of the rail turns up from its firft beginning to 3.

Fig. 3. Shews the fame pitch-board, with the manner of the rail's turning up. If the fides of the twifted part of the rail be fhaped by the rail-mould, fo that they direct down to its ground-plan, that is, the upper fide of

of the rail being first ſtruck by the mould, then apply the mould to the under ſide, as much back as the level of the pitch-board ſhews, by being ſtruck on the ſide of the rail, and then fig. 3. being applied to the outſide of the rail, from its firſt twiſting part to 3, will ſhow how much wood is to be taken off.

Fig. 5. Exhibits the ſquare of the rail, with the raking-line of the pitch-board drawn through the middle on the upper ſide; then draw the depth of the ſide of the rail parallel to this, and the dotted lines from the diagonal of the rail; theſe lines ſhew what quantity of wood will be wanting on the upper and lower ſides of the rail. Set your compaſſes at *c*, and draw the circular ſtroke from the raking part of the pitch-board to *b*; take the diſtance *a b*, and transfer it from *a* to *b*, in fig. 7. The ſeveral diſtances thus found may be ſet at any number of places, ranging with the ſtraight part of the rail; and it then forms the width of the mould for the twiſting part of the rail.

Fig. 7. Shews the ſweep of the rail. The rail cannot be fixed leſs than one fourth part from the *noſing* or front of the ſtep.

The remaining part of the pitch-board may be divided into any number of parts, as here into four; from theſe diviſions draw lines acroſs the pitch-board to the raking-line; then take the diſtances from the ground-line of the pitch-board to the plan of the rail, and ſet them perpendicular from the raking-line of the pitch-board; and theſe diviſions, when the rail is in its proper poſition, lie directly over the diviſions on the ground-plan.

In this figure *l*, *m*, and *n*, riſe as much above *o* as the dotted line in fig. 5. does above the width of the rail; and they ſink as much below *o* as the other dotted line in fig. 5. falls below the width of the rail; the ſame thickneſſes muſt be glued upon *o*, though the greateſt part will come off in ſquaring. The reaſon of placing the letters *l*, *m*, and *n*, where they are, is, that they might not obſtruct the ſmall diviſions of the rail-mould.

Fig. 4. Shews how to find the rail when it takes more than one ſtep. The remaining part of the pitch-board is divided into four parts, as before in fig. 7. and it takes in two ſuch parts of the next ſtep. Draw lines from theſe diviſions to the diagonal of the pitch-board, as in fig. 7.; then take the diſtance *a b*, and ſet it from *c* to *d*, and ſo proceed with the other diviſions.

Another way to find the outſide of the rail-mould is, to draw all the diviſions acroſs the plan of the rail; then take the diſtance from the ground-line of the pitch-board to 4, transfer it from the diagonal of the pitch-board to 4 on the rail; and ſo proceed with the other diſtances. Now, when the rail is put in its proper ſituation, *c* will be perpendicular to *b*, and all the diviſions, as 1, 2, 3, 4, &c. in the rail, will be perpendicular to 1, 2, 3, 4, &c. in the ground-plan.

Fig. 6. Shews the plan of a rail of five ſteps.

To find the rail.—Set five diviſions, as from *e* to *b*, which is the height of the five ſteps; draw the diagonal *b* to the plan of the rail; then take the diſtance *e f*, and transfer it from *g* to *h*, and proceed in the ſame manner with the other ſeven diſtances.

To find the width of the rail-mould.—Draw the lines acroſs the plan of the rail, as at *k*; ſet that diſtance from the diagonal to *i*; and ſo proceed with the reſt, as was ſhewn in fig. 4.

Having formed the ſides of the rail perpendicular to its ground-plan, and having ſquared the lower end of the rail, then take a thin lath, and bend it with the rail, as is repreſented by *m* fig. 1.

This is the readieſt method of ſquaring a ſolid rail; but if the rail be bent in the thickneſſes, the noſing of the ſteps muſt be drawn upon a cylinder, or ſome other ſolid body of a ſufficient width to contain the width of the rail or ſtring-board.

r, Repreſents the depth of the rail, touching the noſe of each ſtep. Take a ſufficient number of thickneſſes of this width, to make the thickneſs of your rail; glue them all together upon your cylinder or templet, confine them till they are dry, and the rail taken off is ready ſquared. Proceed in the ſame manner with the architrave, marked *a*.

OF ROOFS.

Plate XXXVII. Fig. 1. Shews the form of a truſſed roof, with three ring-poſts, that may carry ſeventy feet, or upwards.

Fig. 2. Exhibits an *M* roof, capable of carrying as great an extent as the former. Indeed both theſe deſigns are capable of carrying almoſt any extent.

Fig. 3. Repreſents two different ſorts of truſſes.

Fig. 4. Shews the manner of piecing timber. Sometimes the joint may be extended as far as *a*, with another bolt through it. To the right is ſhewn a different ſort of joint.

Fig. 5. Shews the manner of truſſing a girder. If the truſſes are full long, with the pieces *b* and *c* you may make them as light as you pleaſe.

Fig. 6. Repreſents the manner of truſſing partitions.

Military Architecture, the ſame with what is otherwiſe called fortification. See Fortification.

Naval Architecture, the art of building ſhips. See Ship-building.

Counterfeit Architecture, that which conſiſts of projectures, painted in black or white, or in colours after the manner of marble, which is alſo called ſcene-work, in the painting of columns, &c. for the decoration of theatres.

Architecture, in perſpective, a ſort of building, the members of which are of different modules, and diminiſh proportionably to their diſtance, in order to make the work appear longer to the view than it really is. See Perspective.

ARCHITALASSUS, or admiral-ſhell, a ſynonime of a ſpecies of conus. See CONUS.

ARCHITRAVE, in architecture, that part of a column which lies immediately upon the capital, being the loweſt member of the entablature, and ſo called from its repreſenting the principal beam in timber-buildings. See ARCHITECTURE.

Over a chimney, this member is called the *mantle-piece*; and over doors or windows, the *hyperthyron*.

ARCHIVOLT, in architecture, the inner centre of an arch, or a band adorned with mouldings running over the faces of the arch-ſtones, and bearing upon the impoſts.

ARCHIVE, or ARCHIVES, an apartment in which are depoſited the records, charters, and other papers of a ſtate or community.

ARCHMARSHAL, the grand marſhal of the empire, a dignity belonging to the elector of Saxony.

ARCHON, in Grecian antiquity, the chief magiſtrate of Athens, after the aboliſhing of monarchy; and alſo, the appellation given to ſeveral officers, both civil and religious, under the Greek empire.

ARCHONTICI, in church-hiſtory, a branch of Valentinians, who maintained, that the world was not created by God, but by angels called *Archontes*.

ARCHTREASURER, the great treaſurer of the German empire, a dignity belonging to the duke of Brunſwick, king of Great Britain.

ARCIGOVINO, a province of Dalmatia, bounded by Boſnia, Mantenero, and the Adriatic ſea, and called by the Italians *Santa Sabata*.

ARCILEUTO, a lute longer and larger than ordinary.

ARCION, in botany, an obſolete name of the tuſſilago.

ARCO, a town of the biſhopric of Trent in Italy, ſituated about 16 miles S. W. of Trent, in 10° 46′ E. long. and 46° N. lat.

ARCTAPELIOTES, a term uſed to denote a north-eaſt wind.

ARCTIC, in aſtronomy, an epithet given to the north pole; and likewiſe to a circle of the ſphere, parallel to the equator, and twenty-three degrees thirty minutes diſtant from the north pole. See ASTRONOMY, and GEOGRAPHY.

ARCTICA, in ornithology, a ſynonime of a ſpecies of larus. See LARUS.

ARCTIUM, in botany, a genus of the ſyngeneſia polygamia æqualis claſs. The calix is globular, ſquamous, and hooked at the tops. There are only two ſpecies of arctium, *viz.* the lappa, or burdock, a native of Britain; and the perſonata, a native of the Alps, *&c.* The roots and ſeeds of the lappa are eſteemed to be diuretic and ſudorific. Decoctions of the roots have of late been uſed in rheumatic and gouty diſorders.

ARCTOPHYLAX, a conſtellation, otherwiſe called *Boötes*. See BOOTES.

ARCTOPUS, in botany, a genus of the polygamia diœcia claſs. The umbella of the male is compound; the involucrum conſiſts of five leaves; the corolla has five petals; the ſtamina are five; and two piſtils: The umbella of the hermaphrodite is ſimple; the involucrum is divided into four parts, is ſpinous, large, and contains many male flowers in the diſk. There is but one ſpecies of arctopus, *viz.* the echinatus, a native of Ethiopia.

ARCTOTIS, in botany, a genus of the ſyngeneſia polygamia neceſſaria claſs. The receptacle is briſtly; the corona of the pappus is pentaphyllous; and the calix is imbricated, with the ſcales looſe at the top. There are 11 ſpecies of arctotis, all of them natives of Ethiopia, or the Cape of Good Hope.

ARCTURUS, a fixed ſtar of the firſt magnitude, in the ſkirt of *Boötes*.

ARCTUS, in aſtronomy, the Greek name of the urſa major and minor. See ASTRONOMY, and URSA.

ARCUATION, in gardening, the raiſing of trees by layers. See GARDENING.

ARCUATION, in ſurgery, denotes a diſtortion or incurvation of the bones, as happens in the rickets, *&c.*

ARCUTIO, a machine conſiſting of hoops, uſed in Florence by nurſes, in order to prevent the child from being overlaid. Every nurſe is obliged to lay her child in an arcutio, under the pain of excommunication.

ARCYRIA, in botany. See CLATHRUS.

ARDASSES, the coarſeſt of all the ſilks in Perſia.

ARDEA, in ornithology, a genus of the order of grallæ. The general characters of this order are theſe: The bill is ſtreight, ſharp, long, and ſomewhat compreſſed, with a furrow that runs from the noſtrils towards the point; the noſtrils are linear; and the feet have four toes. This genus conſiſts of 26 ſpecies; and under it Linnæus comprehends the grus or crane, the ciconia or ſtork, and the ardea or heron, of other authors. The firſt ſpecies is the pavonina, or crowned crane, which has an erect briſtly creſt, with the temples and two wattles naked. The head is black; the creſt is yellowiſh, and tipped with black at the top; the wings are white; and the feathers of the tail black, and of an equal length. It is a native of Africa. 2. The virgo has long white ſupercilia that hang down backwards. The body is of a bluiſh aſh-colour, and about the ſize of a ſtork; the head and prime feathers of the wings towards the points are black and pendulous; the edges are red, and the pupils are aſh-coloured; behind the eyes, on both ſides, there is a feathery creſt, which turns backwards a conſiderable way, and is of a white colour: The feet are black; the beak is green at the baſe, yellowiſh in the middle, and red at the point. 3. The canadenſis, or brown and aſh-coloured crane of Edwards, is naked and papillous on the forehead; the body is aſh-coloured, and the wings are of a reddiſh or brick-colour. 4. The grus, or common crane of Engliſh authors, has a naked papillous crown; the prime feathers of the wings are black; the body is aſh-coloured; the prime feathers of the tail are ragged. It is a native of Europe and Africa. It winters in Lithuania, Padolia: *Trans Pontum fugat et terris immittit apricis*. Virg. This bird commonly reſts upon one foot. 5. The americana, or hooping crane of Edwards, is a native of America: The crown of the head and temples are naked and papillous; the forehead, nape of the neck, and prime wing-

wing-feathers are black; but the body is white: The under part of the head, as far as the lower chap, is red; the beak is yellowish, and jagged at the point; the feet are red, and the prime tail-feathers white. 6. The Antigone, or greatest Indian crane of Edwards, has a naked head, and papillous collar; the body is ash-coloured, and the prime wing-feathers black. Behind the eyes, there is a small white spot, and the crown of the head is also white. The breast is of a greenish yellow colour; the feet are red, and the prime tail-feathers ash-coloured. It is a native of Asia. 7. The ciconia, or white stork of Ray, has naked eye-balls, and black prime wing-feathers. The skin below the feathers, as also the beak, feet, and claws, are of a blood-colour. It is a native of Europe, Asia, and Africa; but is seldom or never to be met with in Italy. The ciconia feeds upon amphibious animals. It is such an enemy to serpents, that it is reckoned almost a crime to kill a stork. From this favourable treatment, they are seen in Holland and the Low Countries walking unconcerned in the middle of the streets. Storks are birds of passage; they spend the summer in Europe, and disappear all at once, and go off to Egypt, Ethiopia, *&c.* before winter, and do not return till about the middle of March. 8. The nigra, or black stork of Willoughby, has naked orbits, and the breast and belly are white; the body is black; the feet and orbits are blood-coloured. It inhabits the northern parts of Europe. 9. The nycticorax, or lesser ash-coloured heron of Ray, has a crest, consisting of three strait horizontal white feathers, on the back part of the head; the back is greenish, and the belly yellow. It inhabits the southern parts of Europe. 10. The purpurea, or common heron of English authors, has a crest, with two long green feathers hanging down from the back part of the head; the body is of an olive-colour, and purple below; the head is of a shining green colour. It is a native of the East. 11. The cinerea, or ash-coloured heron, has a smooth black head, a bluish back, white belly, and oblong black spots on the breast. It is a native of Europe. Great numbers of them together build their nests in trees. They are said to fly very high before storms. 12. The major has a black crest depending from the back part of the head, an ash-coloured body, and a black line and belt on the neck and breast. It is a native of Europe. 13. The garzetta is crested behind; the body is white, the beak black, and the feet greenish. It is a native of the East. 14. The cocoi has an ash-coloured crest hanging down from the back part of the head; the whole body is ash-coloured. It is a native of Cayenne. 15. The herodias is crested behind, has a dusky-coloured back, reddish thighs, and the breast speckled with oblong black spots. It is a native of America. 16. The violacea has a white crest; the body is variegated with black and white, and bluish below. It is a native of America. 17. The cærulea has a crest behind, and a bluish body. It is a native of N. America. 18. The hudsonias has a black crest on the top of the head; the body is dusky-coloured, and white below. It frequents Hudson's Bay. 19. The striata has a small crest on the back-part of the head; the back is of a hoary grey colour, and ash-coloured below; the long wing feathers are tipped with white. It is a native of Surinam. 20. The virescens has a small crest on the back part of the head, a green shining back, and dusky-coloured breast. It is a native of America. 21. The stellaris, or bittern, has a smooth head; it is variegated through the whole body with dark-coloured spots of different figures and sizes. It is a native of Europe, and inhabits chiefly the fen-countries. It is met with skulking among the reeds and sedge, and its usual posture is with the head and neck erect, and the beak pointed directly upwards. It will suffer persons to come very near it without rising; and has been known to strike at boys and at sportsmen, when wounded and unable to make its escape. It flies principally about the dusk of the evening, and then rises in a very singular manner, by a spiral ascent, till it is quite out of sight. It makes a very strange noise when it is among the reeds, and a different and very singular one as it rises on the wing in the night. 22. The grisea has a smooth dusky head; the body is tawny above, and white below; and the prime wing-feathers have a black spot at the points. It is a native of the East. 23. The brasiliensis has a smooth head; the body is blackish, with yellow spots; and the prime feathers of the wings and tail are greenish. It is a native of America. 24. The alba has a smooth head, a white body, a yellow beak, and black feet. It is a native of Europe. 25. The æquinoctialis has a smooth head, and a white body. It is a native of America. 26. The minuta has a smooth head, a dark-coloured body, and a yellowish belly. It is about the size of the turdus, and is a native of Switzerland and the East.

ARDENBURG, a fortified town of Dutch Flanders, situated about 12 miles N. E. of Bruges, in 3° 20′ E. long. and 51° 15′ N. lat.

ARDENNE, a forest in Germany, lying between Thionville and Liege.

ARDEVIL, or ARDEBIL, the burying-place of some of the ancient kings of Persia, situated in 64° 20′ E. long. and 36° N. lat.

ARDMAGH, in geography. See ARMAGH.

ARDOR-VENTRICULI, the same with the heart-burn.

ARDRES, a town of the province of Picardy in France, situated about 10 miles south of Calais, in 2° E. long. and 50° 45′ N. lat.

ARDRES, or ARDRA, is also the capital of a country on the slave-coast of Guinea in Africa, situated near the river Lagos, in 4° E. long. and 5° N. lat.

ARE, in music. See ALAMIRE.

AREA, in geometry, denotes the superficial content of any figure. See GEOMETRY.

AREA, among physicians, the same with alopecia. See ALOPECIA.

AREBON, a town of Guinea in Africa, situated at the mouth of the river Formosa, in 5° E. long. and 5° N. lat.

ARECA, in botany, a genus of the order of palmæ pennatifoliæ. The male has no calix, but three petals, and nine stamina; the female has no calix; the

corolla

corolla has three petals, and the calix is imbricated. There is only one ſpecies, *viz.* the cathecu, a native of India.

AREMBERG, a city of Germany, ſituated about 25 miles ſouth of Cologn, in 6° 25′ E. long. and 50° 30′ N. lat.

ARENA, in natural hiſtory. See Sand.

Arena, in Roman antiquity, a place where the gladiators fought; ſo called from its being always ſtrewed with ſand, to conceal from the view of the people the blood ſpilt in the combat.

ARENARIA, or chickweed, in botany, a genus of the decandria trigynia claſs. The calix has five open leaves; the petals are five, and entire; the capſule is unilocular, and contains many ſeeds. There are 17 ſpecies of arenaria, only 7 of which are natives of Britain, *viz.* the peploides, or ſea-chickweed; the trinervia, or plantain-leaved chickweed; the ſerpyllifolia, or leaſt chickweed; the ſaxatilis, or mountain-chickweed; the laricifolia, or larch-leaved chickweed; the tenuifolia, or fine-leaved chickweed; and the rubra, or purple-flowered chickweed.

ARENATION, a kind of dry bath, wherein the patient ſits with his bare feet on hot ſand.

AREOLA, among anatomiſts, the coloured circle ſurrounding the nipple of the breaſt.

AREOPAGUS, a ſovereign tribunal at Athens, famous for the juſtice and impartiality of its decrees, to which the gods themſelves are ſaid to have ſubmitted their differences.

Authors are not agreed about the number of judges that compoſed this auguſt court; ſome reckon thirty-one; others, fifty-one; and others, five hundred. In effect, their number ſeems not to have been fixed, but to have been more or leſs in different years. At firſt, this tribunal conſiſted only of nine perſons, who had all diſcharged the office of Archons, had acquitted themſelves with honour in that truſt, and had likewiſe given an account of their adminiſtration before the Logiſtæ, and undergone a rigorous examination. Their ſalary was equal, and paid out of the treaſury of the republic; they had three oboli for each cauſe. The Areopagites were judges for life; they never ſat in judgment but in the open air, and that in the night-time, to the intent that their minds might be the more preſent and attentive, and that no object of pity or averſion might make any impreſſion on them; and all the pleadings before them were to be in the ſimpleſt and moſt naked terms. At firſt they took cogniſance of criminal cauſes only, but in courſe of time their juriſdiction became of great extent.

Mr Spon, who examined the antiquities of that illuſtrious city, found ſome remains of the Areopagus ſtill exiſting in the middle of the temple of Theſeus, which was heretofore in the middle of the city, but is now without the walls. The foundation of the Areopagus is a ſemicircle, with an eſplanade of 140 paces round it, which properly made the hall of the Areopagus. There is a tribunal cut in the middle of a rock, with ſeats on each ſide of it, where the Areopagites ſat expoſed to the open air. It is very uncertain when this court was inſtituted, ſince Demoſthenes himſelf is at a loſs upon the point: Some think that it was inſtituted by Solon; but others carry it much higher, and aſſert it to have been eſtabliſhed by Cecrops, about the time that Aaron died.

AREQUIPPA, a city of Peru, in S. America, ſituated in 73° W. lon. and 17.° S. lat.

AREHA, in botany, a genus of the pentandria monogynia claſs. The corolla is divided into five parts; the tube of the corolla is ovated; and the capſule is globular, and conſiſts of but one cell. There is only one ſpecies, *viz.* the alpina.

ARETHUSA, in botany, a genus of the gynandria diandria claſs. The generic character is taken from the nectarium, which is tubular, ſituated at the bottom of the corolla; and the inferior labium of it is fixed to the ſtylus. There are four ſpecies of the arethuſa, all natives of America, except the capenſis, which is only found at the Cape of Good Hope.

ARGEMONE, in botany, a genus of the polyandria monogynia claſs. The corolla conſiſts of ſix petals; the calix of three leaves; and the capſule is ſemivalved. There are three ſpecies of argemone, none of which are natives of Britain. They are all a kind of poppies.

AREZZO, a city of Tuſcany in Italy, ſituated in 13° 15′ E. long. and 43° 15′ N. lat.

ARGEA, or Argei, in Roman antiquity, thirty human figures, made of ruſhes, thrown annually by the prieſts or veſtals into the Tiber, on the day of the ides of May.

ARGENT, in heraldry, the white colour in the coats of gentlemen, knights, and baronets. See Heraldry.

ARGENTAN, a city of France, in the Lower Normandy, upon the Orne, in 25′ E. long. and 48° 34′ lat.

ARGENTARIA *creta*, pure white earth, found in Pruſſia, and much eſteemed for cleaning plate.

ARGENTIERE, a ſmall iſland in the Archipelago, ſituated about 60 miles eaſt of Morea, in 25° E. long. and 37° N. lat.

Argentiere is alſo the name of a ſmall town of Languedoc in France, in 4° E. long. and 44° 30′ N. lat.

ARGENTINA, in ichthyology, a genus of fiſhes belonging to the order of abdominales. The generic characters are theſe: The teeth are in the tongue as well as the jaws; the branchioſtege membrane has eight radii or rays; the anus is near the tail; and the belly-fins conſiſt of many rays. There are two ſpecies of argentina, *viz.* 1. The ſphyræna has 15 rays in the fin at the anus; the air-bladder of this ſpecies is conical on both ſides, and ſhines like ſilver: According to Mr Ray, falſe pearls are ſometimes made of it. 2. The carolina has likewiſe 15 rays in the fin near the anus; the tail is forked, and the lateral lines are ſtreight. It inhabits the freſh waters of Carolina.

ARGENTON, a town of France, ſituated about forty-five miles ſouth-weſt of Bourges, in 1° 35′ E. long. 46° 40′ N. lat.

ARGENTUM. See Silver.

ARGILLA, clay, in natural hiſtory. See CLAY.

ARGO, in aſtronomy, a conſtellation of fixed ſtars in the ſouthern hemiſphere; whoſe number of ſtars, in Ptolemy's catalogue, is eight; in Tycho's, eleven; and in Mr Flamſtead's, twenty-five. See ASTRONOMY.

ARGONAUTA, the name of a genus of ſhell-fiſh belonging to the order of vermes teſtacea. The ſhell conſiſts of one ſpiral involuted valve. There are two ſpecies of argonauta, *viz.* The argo with a ſubdented carina, which is found in the Mediterranean and Indian oceans. This is the famous nautilus of other authors. It lies on the ſurface of the water, and extends an exceeding thin membrane, which it uſes in ſome meaſure both as ſails and oars; and in this manner it ſwims from one place to another. 2. The cymbium with a blunt plaited carina. This ſpecies is very ſmall, and is found in the Mediterranean.

ARGONAUTS, in Grecian antiquity, a company of illuſtrious Greeks, who embarked along with Jaſon, in the ſhip Argo, on an expedition to Colchis, with a deſign to obtain the golden fleece.

ARGOS, a ſea-port town of European Turky, in the Morea, ſituated on the bay of Napoli de Romania, in 23° E. long. and 37° 30′ N. lat.

ARGUIN, an iſland on the coaſt of Negritia. It lies on the Atlantic Ocean, about 20′ N. lat.

ARGUMENT, in rhetoric and logic, an inference drawn from premiſes, the truth of which is indiſputable, or at leaſt highly probable. See LOGIC.

ARGUMENT, in aſtronomy, denotes a known arch, by means of which we ſeek another one unknown.

ARGUMENT, in matters of literature, denotes alſo the abridgment or heads of a book, hiſtory, comedy, chapter, *&c.* See SYLLABUS.

ARGUN, a river of Tartary in Aſia, ſerving as a boundary between the Chineſe and Ruſſian empires.

ARGUN is alſo a city of Aſiatic Tartary, ſituated on the above river, in 104° E. long. and 51° 30′ N. lat.

ARGUS-SHELL, a ſpecies of porcelain-ſhell, beautifully variegated with ſpots, reſembling in ſome meaſure thoſe in a peacock's tail.

ARGYLESHIRE, a county of Scotland, lying weſtward of Glaſgow, and comprehending the countries of Lorn, Cowal, Knapdale, Kintyre, together with the iſlands Mull, Jura, Iſla, *&c.* It gives the title of duke to the noble family of Campbell.

ARGYROPOEIA, among alchemiſts, a pretended art of tranſmuting or changing other metals into ſilver.

ARHUSEN, a city of Jutland in Denmark, ſituated at the entrance of the Baltic ſea, in 10° 20′ E. long. and 56° N. lat.

ARIANO, a town of the kingdom of Naples, and province of Principata, ſituated about 15 miles eaſt of Benevento, in 15° 35′ E. long. and 41° 16′ N. lat.

ARIANS, in church-hiſtory, a ſect of ancient heretics, who denied the three perſons in the Holy Trinity to be of the ſame eſſence, and affirmed Chriſt to be a creature.

ARICA, a ſea-port town of Peru in South America, ſituated on the Pacific Ocean, in 70° 20′ W. long. and 18° 20′ S. lat.

ARIDAS, a kind of taffety, manufactured in the E. Indies, from a ſhining thread which is got from certain herbs, whence they are ſtyled *aridas of herbs.*

ARIDULLAM, in natural hiſtory, a kind of zarnich found in the E. Indies. See ZARNICH.

ARIES, in zoology. See OVIS.

ARIES, in aſtronomy, a conſtellation of fixed ſtars, drawn on the globe, in the figure of a ram. It is the firſt of the twelve ſigns of the zodiac, from which a twelfth part of the ecliptic takes its denomination. See ASTRONOMY, *Of the fixed ſtars.*

ARISARUM, in botany. See ARUM.

ARISH, a Perſian long meaſure, containing about 38 Engliſh inches.

ARISI, the Indian name for the plant which produces the rice. See ORYSA.

ARISTA, or AWN, among botaniſts, a long needle-like beard, which ſtands out from the huſk of a grain of corn, graſs, *&c.*

ARISTIDA, in botany, a genus of the triandria digynia claſs. The calix has a double valve; the corolla has one valve, and three awns at the points. There are 3 ſpecies of ariſtida, *viz.* the adſcenſionis, a native of the iſland of Aſcenſion; the Americana, a native of Jamaica; and the plumoſa, a native of America.

ARISTOCRACY, a form of government where the ſupreme power is veſted in the principal perſons of the ſtate. See GOVERNMENT.

ARISTOLOCHIA, in botany, a genus of the gynandria hexandria claſs. It has no calix; the corolla conſiſts of one entire petal; and the capſule, which is below the flower, has 6 cells. There are 21 ſpecies of ariſtolochia, none of which are natives of Britain.

ARISTOLUS, an obſolete name of a ſpecies of clupea. See CLUPEA.

ARITHMETICK.

ARITHMETICK is a ſcience which explains the properties of numbers, and ſhews the method or art of computing them.

We have very little intelligence about the origin and invention of arithmetick; but probably it muſt have taken its riſe from the introduction of commerce, and conſequently

quently be of Tyrian invention. From Aſia it paſſed into Egypt, where it was greatly cultivated. From thence it was tranſmitted to the Greeks, who conveyed it to the Romans with additional improvements. But, from ſome treatiſes of the ancients remaining on this ſubject, it appears that their arithmetick was much inferior to that of the moderns.

Number, which is the object of arithmetick, is that which anſwers directly to the queſtion, How many? and is either an unit, or ſome part or parts of an unit, or a multitude of units.

To a perſon having the idea of number in his mind, the following queſtions naturally occur, *viz.* 1. How is ſuch a number to be expreſſed or written? Hence we have Notation. 2. What is the ſum of two or more numbers? Hence Addition. 3. What is the difference of two given numbers? Hence Subtraction. 4. What will be the reſult or product of a given number repeated or taken a certain number of times? Hence Multiplication. 5. How often is one given number contained in another? Hence Diviſion.

Theſe five, *viz.* Notation, Addition, Subtraction, Multiplication, and Diviſion, are the chief parts, or rather the whole of arithmetic; as every arithmetical operation requires the uſe of ſome of them, and nothing but a proper mixture of them is neceſſary in any operation whatever; and, by an Arabic term, theſe are called the *algorithm*.

Chap. I. Notation.

Notation is that part of arithmetic which explains the method of writing down, by characters or ſymbols, any number expreſſed in words; as alſo the way of reading or expreſſing, in words, any number given in characters or ſymbols. But the firſt of theſe is properly notation, and the laſt is more uſually called *numeration*.

The things then proper to be compriſed in this chapter are, 1. The figural notation. 2. Numeration, or the way of reading numbers. 3. Deſcriptions of the kinds or ſpecies of numbers.

I. *Figural Notation.*

An unit, or unity, is that number by which any thing is called one of its kind. It is the firſt number; and if to it be added another unit, we ſhall have another number called *two;* and if to this laſt another unit be added, we ſhall have another number called *three*; and thus, by the continual addition of an unit, there will ariſe an infinite increaſe of numbers. On the other hand, if from unity any part be ſubtracted, and again from that part another part be taken away, and this be done continually, we ſhall have an infinite decreaſe of numbers. But though number, with reſpect to increaſe and decreaſe, be infinite, and knows no limits; yet ten figures, variouſly combined or repeated, are found ſufficient to expreſs any number whatſoever. Theſe, with the method of notation by them, were originally invented by ſome of the eaſtern nations, probably the Indians; afterwards improved by the Arabians; and at laſt brought over to Europe, particularly into Britain, betwixt the tenth and twelfth century. From the ten fingers of the hands, on which it hath been uſual to compute numbers, figures were called *digits*. Their form, order, and value, are as follows:

1 One, an unit, or unity, 2 two, 3 three, 4 four, 5 five, 6 ſix, 7 ſeven, 8 eight, 9 nine, 0 cipher, nought, null, or nothing. Of theſe, the firſt nine, in contradiſtinction to the cipher, are called *ſignificant figures*.

The value of the figures now aſſigned is called their *ſimple value*, as being that which they have in themſelves, or when they ſtand alone. But when two or more figures are joined as in a line, the figures then receive alſo a local value from the place in which they ſtand, reckoning the order of places from the right-hand towards the left, thus,

&c.	Twelfth place.	Eleventh place.	Tenth place.	Ninth place.	Eighth place.	Seventh place.	Sixth place.	Fifth place.	Fourth place.	Third place.	Second place.	Firſt place.
	7	7	7	7	7	7	7	7	7	7	7	7

A figure ſtanding in the firſt place has only its ſimple value; but a figure in the ſecond place has ten times the value it would have in the firſt place; and a figure in the third place has ten times the value it would have in the ſecond place; and univerſally a figure in any ſuperior place has ten times the value it would have in the next inferior place.

Hence it is plain, that a figure in the firſt place ſimply ſignifies ſo many units as the figure expreſſes; but the ſame figure advanced to the ſecond place will ſignify ſo many tens; in the third place, it will ſignify ſo many hundreds; in the fourth place, ſo many thouſands; in the fifth place, ſo many ten thouſands; in the ſixth place, ſo many hundred thouſands; and in the ſeventh place, ſo many millions, *&c.* Thus, 7 in the firſt place, will denote ſeven units; in the ſecond place, ſeven tens, or ſeventy; in the third place, ſeven hundred; in the fourth place, ſeven thouſand, *&c.*

Every three places, reckoning from the right-hand, make a half period; and the right-hand figures of theſe half-periods are termed *units* and *thouſands* by turns; the middle figure is always tens, and the left-hand figure always hundreds.

Two half-periods, or ſix places, make a full period; and the periods, reckoning from the right-hand towards the left, are titled as follows, *viz.* the firſt is the period of *units*; the ſecond, that of *millions;* the third is titled *bimillions*, or *billions*; the fourth, *trimillions*, or *trillions*; the fifth, *quadrillions;* the ſixth, *quintillions*; the ſeventh *ſextillions;* the eighth, *ſeptillions;* the ninth, *octillions*; the tenth, *nonillions*, &c.

Half-periods are uſually diſtinguiſhed from one another by a comma, and full periods by a point or colon; as in the following

TABLE.

TABLE.

3d Period.						2d Period.						1st Period.					
Billions.						Millions.						Units.					
Hundred thousands.	Ten thousands.	Thousands.	Hundreds.	Tens.	Units.	Hundred thousands.	Ten thousands.	Thousands.	Hundreds.	Tens.	Units.	Hundred thousands.	Ten thousands.	Thousands.	Hundreds.	Tens.	Units.
8	1	3,	7	0	0.	2	3	7,	8	9	4.	6	7	8,	0	4	0.

The table may be expressed in a more concise form thus,

3.	2.	1. Per.
Billions.	Millions.	Units.
813,700:	237,894:	678,040.

From the table it is obvious, that though a cipher signify nothing of itself, yet it serves to supply vacant places, and raises the value of significant figures on its left hand, by throwing them into higher places. Thus, in the first period, by a cipher's filling the place of units, the figure 4 is thrown into the place of tens, and signifies forty. But a cipher does not change the value of a significant figure on its right-hand. Thus, 07, or 007, is the same as 7.

II. *Numeration.*

NOTATION and numeration are so nearly allied, that he who understands the one cannot fail soon to acquire the other. The method of reading numbers, expressed by figures, may be easily learned from the table of the figural notation; in which observe the following

RULE. Beginning at the left hand, and reading toward the right; to the simple value of every figure join the name of its place, and conclude each period by expressing its title, every where omitting the ciphers.

III. *Descriptions of the kinds or species of numbers.*

1. AN *integer*, or *whole number*, is an unit, or any multitude of units; as 1, 7, 48, 100, 125.

2. A *fraction*, or *broken number*, is any part or parts of an unit; and is expressed by two numbers, which are separated from one another by a line drawn betwixt them; the under number being called the *denominator*, and the upper one the *numerator*, of the fraction; as $\frac{1}{2}$, $\frac{3}{4}$, $\frac{9}{10}$.

3. A *mixt number* is an integer with a fraction joined to it; as $4\frac{1}{2}$, $7\frac{3}{4}$, $48\frac{5}{6}$.

4. A number is said to *measure* another number, when it is contained in that other number a certain number of times, or when it divides that other number without any remainder. Thus, 3 measures 6, 9, or 12.

5. An *even number* is that which is measured by 2, or which 2 divides without any remainder; as 2, 4, 6, 8, 10, 12.

6. An *odd number* is that which 2 does not measure, or which cannot be divided by 2, without a remainder; as 1, 3, 5, 7, 9, 11, 13.

7. A *prime number* is that which unity, or itself, only measures; as 3, 5, 7, 11, 13, 17, 19.

8. A *composite number* is that which is measured by some other number than itself, or unity; as 12, which is measured by 2, 3, 4, or 6.

9. Numbers are called *prime* to one another, when unity only measures them. Thus 13 and 36 are prime to one another; for no number, except unity, measures both.

10. Numbers are called *composite* to one another, when some number, besides unity, measures them. Thus 12 and 18 are composite to one another; for 3 or 6 measures both of them.

11. A number which measures another is called an *aliquot part* of that other. Thus 6 is an aliquot part of 18, and 3 of 12, and 5 of 20.

12. The number measured, or which contains the aliquot part a certain number of times, is called a *multiple* of that *aliquot part*. Thus 18 is a multiple of 6, and 12 of 3.

13. A number is called an *aliquant part* of another, when it does not divide that other without a remainder. Thus 7 is an aliquant part of 24.

14. Two, three, or more numbers, which, multiplied together, produce another number, are called the *component parts* of the number produced. Thus 3 and 4, 2 and 6, are the component parts of 12; and 2, 3, and 4, are the component parts of 24.

15. The product of a number multiplied into itself is called the *square*, or *second power*, of that number; and the number itself is in this case called the *root*. And if the square be multipled into the root, the product is called the *cube*, or *third power*, of that number. And if the cube be multiplied into the root, the product thence arising is called the *biquadrate*, or *fourth power*, &c.

CHAP. II. ADDITION.

ADDITION is the collecting of two or more numbers into one sum or total.

I. *Addition of Integers.*

RULE I. Set figures of like places under other, *viz.* units under units, tens under tens, *&c.*

II. Beginning at the lowest place, set down the right-hand figures of the sum of every column, and carry the rest as so many units to the next superior place.

EXAMP. I. Because similar or like things only can be added, place the numbers as directed in Rule I. *viz.* units under units, tens under tens, *&c.* as in the margin. Then beginning at the lowest place, *viz.* that of units; say, 4 units and 3 units make 7 units, which set below in the place of units; then 3 tens and 5 tens make 8 tens, which set below in the place of tens; then 2 hundreds and 4 hundreds make 6 hundreds, which set below in the place of

$$\begin{array}{r} 453 \\ 234 \\ \hline 687 \end{array}$$

of hundreds, and you will find the ſum or total to be 687.

Examp. II. Having placed the numbers, units under units, *&c.* as in the margin, ſay 2 and 1 make 3, and 3 make 6, and 4 make 10; which being juſt 1 ten, and nothing over, ſet the right-hand figure 0 in the place of units; and becauſe ten in any lower place makes but one in the next ſuperior place, carry 1 ten, as directed in Rule II. ſaying, 1 ten, collected out of the units, and 6 tens, make 7 tens, and 4 make 11, and 0 makes but ſtill 11, and 7 make 18; here again ſet down the right-hand figure 8, in the place of tens, and carry the remaining figure 1, being 1 hundred, to the next place, *viz.* that of hundreds; and having in like manner added up this column, the amount is 31; ſet down the right-hand figure 1 in the place of hundreds, and carry the remaining figure 3 to the next place or column; which being alſo added, amounts to 24; ſet the right-hand figure 4 below, in its proper place, and the remaining figure 2, which belongs to the next place, ſet on the left hand, there being no figure in the next place to which it can be carried. So the ſum or total is 24180.

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 5974
 9803
 7541
  862
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24180
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II. *Addition of the parts of integers, ſuch as ſhillings, pence, farthings, ounces,* &c.

Rule I. Place like parts under other; *viz.* farthings under farthings, pence under pence, *&c.*

II. Begin at the loweſt of the parts, and carry according to the value of an unit of the next ſuperior denomination; *viz.* for every four in the ſum of farthings carry 1 to the pence, and for every twelve in the pence carry 1 to the ſhillings, *&c.*

III. If you carry at 20, 30, 40, 60, or any juſt number of tens, as in adding ſhillings, degrees, poles, minutes, ſeconds, *&c.* proceed with the column of units as in addition of integers, and from the ſum of the column of tens carry 1 for every two, or 1 for every three, *&c.* according as 20 or two tens, thirty or three tens, *&c.* make an unit of the next ſuperior denomination. The reaſon appears plain in the following operations.

1. MONEY.

TABLE.

4 farthings	make	1 penny
12 pence		1 ſhilling
20 ſhillings		1 pound

Marked thus.

l. *s.* *d.* *f.* or *q.*

1 = 20 = 240 = 960

Note, The above mark ſignifies *equal to.*

l. is put for *libra*, a pound; *d.* for *denarius*, a penny; and *q.* for *quadrans*, a fourth-part; but *f* is now the more uſual mark for farthings.

That the learner may proceed in addition of money with the greater eaſe, it will be proper he get the following table by heart.

MONEY-TABLE.

f.		*d.*	*s.*	*s.*	*l.*
4 =	1	12 =	1	20 =	1
8 =	2	24 =	2	40 =	2
12 =	3	36 =	3	60 =	3
16 =	4	48 =	4	80 =	4
20 =	5	60 =	5	100 =	5
24 =	6	72 =	6	120 =	6
28 =	7	84 =	7	140 =	7
32 =	8	96 =	8	160 =	8
36 =	9	108 =	9	180 =	9
40 =	10	120 =	10	200 =	10

Examp. Having, according to Rule I. placed like parts under other, *viz.* farthings under farthings, pence under pence, *&c.* and in each of theſe denominations, units under units, tens under tens, as in the margin, begin with the loweſt of the parts, *viz.* the farthings; and ſay, 2 farthings and 1 farthing make 3 farthings, and 2 make 5, and 3 make 8; which, by the money-table, is 2 fours, or 2 pence, and nothing over; wherefore place 0 below in the place of farthings, or rather leave that place blank, and carry 2 pence to the place of pence, as directed in Rule II, ſaying, 2 pence, collected out of the farthings, and 9 make 11, and 8 make 19, and 1 (paſſing the 0) make 20; to this ſum of units add the tens. Thus, 20 and 1 ten make 30, and 1 ten more make 40 pence; which, by the money-table, is 3 twelves, or 3 ſhillings, and 4 pence over; theſe 4 pence ſet below in the place of pence, and carry 3 ſhillings to the place of ſhillings. Thus, 3 ſhillings, collected out of the pence, and 1 ſhilling make 4, and 7 make 11, and 9 make 20, and 8 make 28; and becauſe in ſhillings we carry at a juſt number of tens, *viz.* at 20, ſet the right-hand figure 8 below in the place of units, as directed in Rule III. and carry the 2 tens to the place of tens. Thus 2 tens collected out of the units, and 1 ten make 3 tens, and 1 make 4, and 1 make 5 tens, or 2 twenties, and 1 ten over; and becauſe 2 tens, or 1 twenty, make an unit in the next place, *viz.* that of pounds, ſet the 1 ten below in the place of tens, and carry the 2 twenty ſhillings, or 2 pounds, to the place of pounds; which, being integers, are added as taught in addition of integers.

(10)	(20)	(12)	(4)
L.	*s.*	*d.*	*f.*
74	18	11	3
96	9	10	2
58	17	8	1
63	11	9	2
293	18	4	

It is uſual to ſubjoin the farthings to the pence by way of fraction, as in the margin, where the former example is tranſcribed in this form for the learner's inſtruction; in which $\frac{1}{4}$ denotes one farthing, $\frac{1}{2}$ two farthings, and $\frac{3}{4}$ three farthings.

L.	*s.*	*d.*
74	18	$11\frac{3}{4}$
96	9	$10\frac{1}{2}$
58	17	$8\frac{1}{4}$
63	11	$9\frac{1}{2}$
293	18	4

In adding up large accounts, ſome dot at 60 in the pence, and for every dot carry 5 to the ſhillings; and in adding the ſhillings they dot likewiſe at 60, and for every dot carry 3 to the pounds. Others chuſe to divide them

them into parcels, then caſt up each parcel ſeparately, and afterwards add the ſums of the ſeveral parcels into one total.

2. AVOIRDUPOIS WEIGHT.

TABLE.

16 drams	make	1 ounce.
16 ounces		1 pound.
28 pounds		1 quarter.
4 quarters		1 hundred.
20 hundreds		1 tun.

Marked thus.

T.	*C.*	*Q.*	*lb.*	*oz.*	*dr.*
1 =	20 =	80 =	2240 =	35840 =	573440
	1 =	4 =	112 =	1792 =	28672

By Avoirdupois weight are weighed butter, cheeſe, roſin, wax, pitch, tar, tallow, ſoap, ſalt, hemp, flax, beef, braſs, iron, ſteel, tin, copper, lead, allum, and all grocery wares.

Note, $19\frac{1}{2}$ C. of lead make a fodder.

In adding the following example, begin with the ounces, and ſay, 15 and 10 make 25; which being above 16, dot, and carry away the exceſs 9, ſaying, 9 of exceſs and 6 make 15, and 8 make 23; where again dot, and carry away the exceſs 7, ſaying, 7 and 2 is 9, and 1 ten on the left is 19; where dot, and proceed with the exceſs 3, ſaying, 3 and 4 is 7, and 1 ten on the left is 17; where dot, and carry the exceſs 1, ſaying, 1 and 5 is 6, and 1 ten on the left is 16; where again dot, and there being no exceſs, you have nothing to ſet down.

(10) *T.*	(20) *C.*	(4) *Q.*	(28) *lb.*	(16) *oz.*
74	19	3	27.	15.
85	17	2	24.	14.
68	13	1	20	12.
52	18	3	19.	8.
50	10	2	18.	6
48	9	3	16	10.
97	5	1	3	15
478	15	3	20	

Proceed now to add the pounds; ſaying 5 carried from the ounces, *viz.* one for every dot, and 3 make 8, and 6 make 14, and 1 ten on the left is 24, and 8 make 32; which being above 28, dot, and go on, ſaying, 4 of exceſs and 1 ten on the left is 14, and 9 is 23, and 1 ten on the left is 33; where again dot, and go on, ſaying, 5 of exceſs and 20 is 25, and 4 is 29; where dot, and proceed, ſaying, 1 of exceſs and 2 tens on the left make 21, and 7 make 28; where dot, and the 2 tens, or 20, on the left, ſet below.

We ſhould now proceed to add the quarters; ſaying, 4 carried from the pounds and 1 make 5, *&c.*; but as you carry here 1 for every four, the quarters are added exactly as the farthings in addition of money. In the hundreds you carry at 20; which, therefore, are added as ſhillings. The tuns are integers; and added accordingly.

III. *Proof of Addition.*

Addition may be proved ſeveral ways.

1. Merchants and men of buſineſs uſually add each column firſt upwards, and then downwards, and, upon finding the ſum to be the ſame both ways, they conclude the work to be right: and this is all the proof that their time, or the hurry of buſineſs, will admit of.

2. It is a common practice in ſchools, to prove the work by a ſecond ſumming without the top-line; and if thus ſum added to the top-line makes the firſt total, the work is ſuppoſed to be right; as in the following example.

	L.	*s.*	*d.*
Top-line	748	15	$10\frac{3}{4}$
	674	13	$11\frac{1}{2}$
	835	17	$9\frac{1}{4}$
	90	18	8
Total	2350	6	$3\frac{1}{2}$
Total without the top-line	1601	10	$4\frac{3}{4}$
Proof	2350	6	$3\frac{1}{2}$

Note, This mark + ſignifies *added to*.

3. Addition is alſo proved by caſting out the 9's; for if the exceſs above the 9's in the total be the ſame as the exceſs in the items, the work may be preſumed right. Thus, to prove the example in the margin, begin with the items, and ſay, $3+4=7$, and $7+7=14=1+4=5$; with this 5 paſs to the next item, and ſay, $5+6=11=1+1=2$, and $2+8=10=1$, and $1+4=5$; which 5 being the exceſs of the items, place at the top of the croſs, and proceed to caſt the 9's out of the total, ſaying, $1+3=4$, and $4+1=5$; which 5, being the exceſs of the total, place at the foot of the croſs; and becauſe it is the ſame with the figure at the top, you conclude the work to be right.

$$\begin{array}{r} 347 \\ 684 \\ \hline 1031 \end{array} \qquad \begin{array}{c} 5 \\ \times \\ 5 \end{array}$$

If the items are of different denominations; as pounds, ſhillings, pence, *&c.*; you muſt begin with the higheſt denomination; and, after caſting out the 9's, reduce the exceſs to the next inferior denomination; and then caſting out the 9's, reduce the exceſs to the next inferior denomination; proceed in like manner with this, and all the other lower denominations, placing the laſt exceſs at the top of the croſs; then, in the ſame manner, caſt the 9's out of the total, placing the exceſs at the foot of the croſs; and if the figure at the foot and top be the ſame, the work may be preſumed right.

If any operation, whether in addition, ſubtraction, multiplication, or diviſion, be right, this kind of proof will always ſhow it to be ſo; but if an operation be wrong, by a figure or figures being miſplaced, or by miſcounting 9, or any juſt number of 9's, this kind of proof will not diſcover the miſtake.

Chap. III. Subtraction.

Subtraction is the taking a leſſer number from a greater, in order to diſcover their difference, or the remainder.

I. *Subtraction of Integers.*

Rule I. Set figures of like place under other, *viz.* units under units, tens under tens, *&c.* and the greater of the given numbers uppermoſt.

II. Beginning at the place of units, take the lower figures from thoſe above, borrowing and paying ten, as need requires, and write the remainders below.

Examp. I. Becauſe ſimilar or like things only can be ſubtracted, place the numbers as directed in Rule I. *viz.* units under units, tens under tens, *&c.* and the greateſt uppermoſt, as in the margin.

867	major, or minuend.
562	minor, or ſubtrahend.
305	difference, or remainder.

Then, beginning at the place of units, ſay, 2 units from 7 units, and 5 units remain; which ſet below in the place of units; then 6 tens from 6 tens, and nothing remains; wherefore ſet 0 below, in the place of tens; then 5 hundred from 8 hundred, and 3 hundred remain; which ſet below, in the place of hundreds; and you will find the total difference or remainder to be 305.

II. Having placed the numbers, units under units, *&c.* as in the margin, ſay, 5 units from 2 units, you cannot, but, becauſe an unit in the next ſuperior place makes ten in this place, you muſt borrow 1, *viz.* 1 ten, from the ſaid next place, as directed in Rule II.; which 1 ten being added to 2 makes 12; then ſay, 5 from 12, and 7 remains; which 7 ſet below in the place of units; then proceed, and pay the unit borrowed, either by eſteeming 3, the next figure in the major, to be only 2, or, which is more uſual, and the ſame in effect, by adding 1 to the next figure in the minor, thus, 1 that you borrowed and 8 make 9, from 3 you cannot, but, borrowing as before, you ſay, 9 from 13 and 4 remains; which 4 ſet below: proceed, and ſay, 1 that you borrowed and 7 make 8, from 4 you cannot, but from 14, and 6 remains; which 6 ſet below: go on, and ſay, 1 borrowed and 2 make 3, from 7, and 4 remains; which 4 ſet below. So the difference or remainder is 4647.

7432
2785
4647

II. *Subtraction of the parts of Integers; ſuch as Shillings, Pence, Farthings, Ounces,* &c.

Rule I. Place like parts under other, *viz.* farthings under farthings, pence under pence, *&c.* and the greater of the given numbers uppermoſt.

II. Begin at the loweſt of the parts, and borrow according to the value of an unit of the next ſuperior denomination; *viz.* in farthings borrow 4, in pence borrow 12, *&c.* as the tables of money and weights direct.

III. If you borrow 20, 30, 40, 60, or any juſt number of tens, as in ſubtracting ſhillings, degrees, poles, minutes, ſeconds, *&c.* proceed with the right-hand column, as in ſubtraction of integers; and then ſubtract your tens, borrowing, if need be, the number of tens contained in an unit of the next ſuperior denomination. The reaſon appears plain in the following operations.

1. M O N E Y.

Having, according to Rule I. placed like parts under other, *viz.* farthings under farthings, pence under pence, *&c.* and in each of theſe denominations, units under units, tens under tens, and the greater of the given numbers uppermoſt, as in the magin, begin with the farthings, and ſay, 2 from 2, and 0 remains; and proceed to the pence, ſaying, 6 from 10 and 4 remains; which 4 ſet down, and go on to the ſhillings, ſaying 2 from 5 and 3 remains, and 1 from 1, and 0 remains; or you may ſay at once, 12 from 15, and 3 remains; which 3 being ſet down, proceed to the pounds, which are integers, and ſubtracted as ſuch.

(10)	(20)	(12)	(4)	
L.	*s.*	*d.*	*f.*	
73	15	10	2	major.
48	12	6	2	minor.
25	3	4		remainder.

In this example ſay, 3 farthings from 1 farthing you cannot, but as directed in Rule II. you ſay, 3 from 4, the number of farthings in 1 penny borrowed, and 1 remains; which 1 added to 1 in the major gives 2 farthings for a remainder; which ſet down, and proceed to the pence, ſaying, 1 penny borrowed and 10 make 11, which from 6 you cannot, but from 12, the number of pence in 1 ſhilling, and 1 remains; which 1 added to 6 in the major gives a remainder of 7; which ſet down, and go on to the ſhillings; and becauſe in ſubtracting ſhillings we borrow a juſt number of tens, *viz.* 2 tens, or 20, work as directed in Rule III.; and in the right-hand column ſay, 1 borrowed and 7 make 8, which from 4 you cannot, but from 14, and 6 remains; which being ſet down, go on to the left-hand column, and ſay, 1 borrowed and 1 make 2, which from 1 you cannot, but from 2, the number of tens in 1 pound, and nothing remains, which 0 added to 1 in the major gives 1 for a remainder; which ſet down, and proceed to the pounds, ſaying, 1 borrowed and 8 make 9, which from 8 you cannot, but from 18, *&c.*

(10)	(20)	(12)	
L.	*s.*	*d.*	
708	14	$6\frac{1}{2}$	major.
170	17	$10\frac{3}{4}$	minor.
429	16	$7\frac{1}{2}$	remainder.

Note, Some add the number borrowed to the figure or number in the major, and then ſubtract from their ſum. Thus, in the farthings they add the 4 borrowed to 1 in the major, and then from the ſum 5 they ſubtract the 3 in the minor; and in the pence they add the 12 borrowed to 6 in the major, and ſubtract from the ſum 18, *&c.*; but the method taught above is the eaſieſt and moſt uſual.

2. AVOIRDUPOIS WEIGHT.

Begin with the pounds, and ſay, 24 from 22 you cannot, but from 28, the number of pounds in 1 quarter, and 4 remains, which added to 22 in the major, gives 26 for

(10)	(4)	(28)	
C.	*Q.*	*lb.*	
84	1	22	major.
49	3	24	minor.
34	1	26	rem.

26 for a remainder; which set below; and proceed to the quarters, saying, 1 quarter borrowed and 3 make 4, which from 1 you cannot, but from 4, the number of quarters in 1 C. and 0 remains, which 0 added to 1 in the major gives 1 for a remainder; which set down, and go on to the C. which are integers, saying, 1 C. borrowed and 9 make 10, which from 4 you cannot, but from 14, *&c.*

III. *The Proof of Subtraction.*

MERCHANTS and men of business use no other proof besides a revisal of the work, or running over it a second time; but it is usual in schools to put the learner upon proving the operation, by some of the three methods following, *viz.*

1. The work may be proved by addition; for if you add the remainder to the minor, the sum will be equal to the major, as in the following example.

Examp.	*L.*	*s.*	*d.*
major	73	15	10
minor	48	12	6
rem.	25	3	4
proof	73	15	10

2. By subtraction; for if you subtract the remainder from the major, the difference will be equal to the minor, as follows.

		L.	*s.*	*d.*
5847	major	73	15	10
2569	minor	48	12	6
3278	rem.	25	3	4
2569	proof	48	12	6

3. By casting out the 9's; for the major being equal to the sum of the minor and remainder, if you cast the 9's out of the major, and place the excess at the top of the cross, and then cast the 9's out of the minor and remainder, as if they were items in addition, and place the excess at the foot of the cross, it is plain the figure at the top and foot, if the work be right, will be the same. Only, in proving subtraction of money, Avoirdupois weight, *&c.* care must be taken to begin with the highest denomination, reducing always the excess to the next inferior denomination, as taught in the proof of addition. See the following example.

	L.	*s.*	*d.*	
major	73	15	10	7
minor	48	12	6	X
rem.	25	3	4	7

CHAP. IV. MULTIPLICATION.

IN multiplication there are two numbers given, *viz.* one to be multiplied, called the *multiplicand;* and another that multiplies it, called the *multiplier;* these two go under the common name of *factors;* and the number arising from the multiplication of the one by the other is called the *product*, and sometimes the *fact*, or the *rectangle.* If a multiplier consists of two or more figures, the numbers arising from the multiplication of these several figures into the multiplicand, are called *particular*, or *partial products;* and their sum is called the *total product.*

Multiplication then is the taking or repeating of the multiplicand, as often as the multiplier contains unity. Or,

Multiplication, from a multiplicand and a multiplier given, finds a third number, called the *product*, which contains the multiplicand as often as the multiplier contains unity.

Hence multiplication supplies the place of many additions; for if the multiplicand be repeated or set down as often as there are units in the multiplier, the sum of these, taken by addition, will be equal to the product by multiplication. Thus, $5 \times 3 = 15 = 5 + 5 + 5$.

The first and lowest step in multiplication is, to multiply one digit by another; and the fact or number thence arising is called a *single product.* This elementary step may be learned from the following table, commonly called *Pythagoras's table of multiplication:* which is consulted thus; seek one of the digits or numbers on the head, and the other on the left side, and in the angle of meeting you have their product. The learner, before he proceed further, ought to get the table by heart.

To Pythagoras's table are here added, on account of their usefulness, the products of the numbers 10, 11, 12.

TABLE.

1	2	3	4	5	6	7	8	9	10	11	12
2	4	6	8	10	12	14	16	18	20	22	24
3	6	9	12	15	18	21	24	27	30	33	36
4	8	12	16	20	24	28	32	36	40	44	48
5	10	15	20	25	30	35	40	45	50	55	60
6	12	18	24	30	36	42	48	54	60	66	72
7	14	21	28	35	42	49	56	63	70	77	84
8	16	24	32	40	48	56	64	72	80	88	96
9	18	27	36	45	54	63	72	81	90	99	108
10	20	30	40	50	60	70	80	90	100	110	120
11	22	33	44	55	66	77	88	99	110	121	132
12	24	36	48	60	72	84	96	108	120	132	144

I. *Multiplication of Integers.*

RULE I. Set the multiplier below the multiplicand, so as like places may stand under other, *viz.* units under units,

units, tens under tens, *&c.*: but if either or both of the factors have ciphers on the right hand, set their first significant figures under other.

The order prescribed in this rule is not absolutely necessary, but very convenient as will appear in the examples.

II. Beginning at the right hand, multiply each figure of the multiplier into the whole multiplicand, carrying as in addition, and placing the right-hand figure of each particular product directly under the multiplying figure.

III. Add the particular products, and their sum will be the total product.

EXAMP. I. Having placed the multiplier under the multiplicand, as directed in Rule I. proceed to the operation, and say, 7 times 4 make 28; set the 8 below in the place of units, and carry the 2 tens to the next place, as dircted in Rule II. saying 7 times 9 make 63, and 2 that I carried make 65; set 5 below in the place of tens, and the 6, which belongs to the next place, set on its left hand, there being no further place to which it can be carried; so the product is 658.

Factors	94	multiplicand.
	7	multipler.
	658	product.

II. Here first multiply the right-hand figure 8 into the whole multiplicand, as in the former example; then proceed, and multiply likewise the 6 tens into the whole multiplicand, saying 6 times 2 make 12; set the 2 below under the the multiplying figure, *viz.* in the place of tens, and carry the 1 to the next place, as directed in Rule II. The reason why the 2 is set under the multiplying figure, or in the place of tens, is, because the multiplying figure 6 is really 6 tens or 60, and 60 times 2 make 120; so that by carrying the 1 to the next place, and setting down 20, the 0 would fall into the place of units, and throw the 2 into the place of tens; but as 0 can make no alteration in the addition of the partial products, the setting of it down is safely and justly omitted.

742	multiplicand.
68	multiplier.
5936	particular
4452	products.
50456	total product.

III. When the multiplier has ciphers on the right hand, as it would be evidently lost labour to multiply by the ciphers, their only use being to throw figures on their left hand into higher places, set the first significant figures of the factors under other; and, after the operation is finished, annex the ciphers of the multiplier to the right hand of the product.

853
72000
1706
5971
61416000

IV. When the multiplier has ciphers intermixed with significant figures, omit the ciphers, because the multiplying by them would only produce so many lines of ciphers and so be labour in vain; wherefore multiply by the significant figures only; but take care to place the right-hand figure of each particular product directly under the multiplying figure.

29601847
300905
148009235
266416623
88805541
8907343771535

Contractions, and simple ways of working multiplication of integers.

1. To multiply any number by 10, by 100, by 1000, *&c.* to the given number annex one, two, three ciphers, *&c.* Thus, $23 \times 10 = 230$; and $384 \times 100 = 38400$; and $745 \times 1000 = 745000$.

2. To multiply any number by 9, by 99, by 999, *&c.* multiply the given number first by 10, by 100, by 1000, *&c.* that is, annex one, two, three, *&c.* ciphers to it; from this subtract the given number, and the remainder is the product; as in the following examples.

Ex. 1.		*Ex.* 2.		*Ex.* 3.	
Mult.	47	Mult.	627	Mult.	999
by 9	470	by 99	62700	by 999	999000
Sub.	47	Sub.	627	Sub.	999
Prod.	423	Prod.	62073	Prod.	998001

From *Ex.* 3. we may learn, in general, that to multiply any number consisting entirely of 9's by itself, is to set 1 in the place of units, then as many ciphers, save one, as there are 9's in the given number; then 8, and on the left hand of 8 as many 9's as there are ciphers on its right.

3. To multiply any number by 5; first multiply it by 10, that is, annex a cipher to it, and then halve it: and to multiply any number by 15, use the same method; and add both numbers together, as in the following examples.

Multiply	7439	Multiply	9856	
by 5 —	74390	by 15 —	98560	add
			49280	
Product	37195	Product	147840	

4. To multiply any number by 11, 12, 13, 14, 15, 16, *&c.* multiply by the unit's figure, and add the back-figure of the multiplicand to the product; and to multiply by 21, 22, 23, 24, 25, 26, 27, *&c.* add the double of the back-figure; and to multiply by 31, 32, 33, 34, *&c.* add the triple of it; and to multiply by 112, 113, 114, *&c.* add the two back-figures; and to multiply by 101, 102, 103, 104, *&c.* add the next back-figure save one: as in the following examples.

Ex. 1.				*Ex.* 2.
876	or multiply by	876 or thus,	876	694
11	11 thus	876	876	14
9636		9636	9636	9716

Ex. 3.	*Ex.* 4.
435	241
27	34
11745	8194

Ex. 5.			*Ex.* 6.	*Ex.* 7.
7234	or thus,	7234	263	745
112		7234	119	103
		7234		
810208		7234	31297	76735
		810208		

In

In multiplying by 12, as in Ex. 8. it is more uſual, and equally eaſy, to proceed by ſaying, twelve times 8 make 96, and, ſetting down the 6, ſay, twelve times 4 is 48, and 9 carried is 57; which ſet down, and the product is 576.

Ex. 8.
48
12
576

5. If the multiplier conſiſt of the ſame figure repeated, as 111, 222, 333, 777, *&c.* multiply by the unit's figure, and out of that product make up the total product, thus. Begin at the right hand, and firſt take one figure, then the ſum of two, then the ſum of three, *&c.* repeating the operation ſtill from the right hand, as often as there are figures in the multiplier; then neglecting the right-hand figure, or figure in the firſt place, take the ſum of as many figures toward the left hand as the multiplier has places; and if there be not ſo many, take the ſum of all the figures there are; then, neglecting the figures in the firſt and ſecond place, begin at the figure in the third place, proceed as before; and thus go on till the laſt or left-hand figure is taken in alone; as in the following examples.

Ex. 1.	*Ex.* 2.	*Ex.* 3.
7645	4983	38
33	666	4444
22935 pr. by 3.	29898 pr. by 6.	152 pr. by 4.
252285 total.	3318678 total.	168872 total.

6. The operation may frequently be rendered ſhorter or eaſier, either by addition, ſubtraction, or a more ſimple multiplication; and the caſes of this kind are ſo numerous and various, that they admit of no limitation. Conſult the following examples and directions.

Ex. 1.	*Ex.* 2.	*Ex.* 3.
438	374	746
87	56	84
3066	2244	2984
3504	1870	5968
38106	20944	62664

Work the above examples as follows.

Ex. 1. Multiply by 7, and add that product to the multiplicand, inſtead of multiplying by 8.

Ex. 2. Multiply by 6, and out of that product ſubtract the multiplicand, inſtead of multiplying by 5.

Ex. 3. Multiply by 4, and double that product for 8.

II. *Multiplication of the parts of Integers.*

Here there are three caſes.

1. If your multiplier is a ſingle digit, ſet it under the units figure of the loweſt denomination, multiply it into all the parts of the multiplicand, beginning at the loweſt, and carrying always as in addition, or according to the value of the next ſuperior place.

Examp. What is the price of 7 packs of cloth at L. 64, 8 s. $10\frac{1}{2}$d. *per* pack?

L.	*s.*	*d.*
64	8	$10\frac{1}{2}$
		7
451	2	$1\frac{1}{2}$

Here ſay, 7 times 2 is 14, which is 3 pence and 2 farthings over; ſet down the 2 farthings, and carry 3 to the place of pence, ſaying, 7 times 10 is 70, and 3 that I carried makes 73, which is 6 ſhillings and 1 penny; ſet down the 1 penny, and carry 6 to the place of ſhillings, ſaying, 7 times 8 is 56, and 6 that I carried is 62, which makes 3 pounds and 2 ſhillings; ſet down the 2 ſhillings, and carry 3 to the place of pounds which are integers.

2. If your multiplier conſiſts of two or more figures, multiply continually by its component parts, or by the component parts of the compoſite number that comes neareſt to it, and then multiply the given multiplicand by the difference of the multiplier, and the neareſt compoſite number: the ſum or difference of theſe two products is the anſwer.

Examp. I. What is the price of 56 C. tobacco, at L. 2 : 14 : $9\frac{1}{4}$ *per* C.

Here the component parts are 8 and 7; for $8 \times 7 = 56$: therefore,

Multiply firſt by 8, and that product by 7; or, which will give the ſame anſwer, multiply firſt by 7, and then that product by 8.

L.	*s.*	*d.*
2	14	$9\frac{1}{4}$
		8
21	18	6
		7
153	9	6

Examp. II. What is the price of 126 yards of velvet, at L. 3 : 8 : 4 *per* yard?

Here multiply firſt by 6, that product by 7, and that product again by 3: but as the component parts are various, and may be choſen at pleaſure, you would have had the ſame anſwer, had you multiplied by $9 \times 7 \times 2$; or by $7 \times 3 \times 3 \times 2$.

L.	*s.*	*d.*
3	8	4
		6
20	10	
	7	
143	10	
	3	
430	10	

From the above example may be deduced a general and eaſy rule for working all queſtions of this kind; and is of excellent uſe when the multiplier happens to be a number; *viz.*

Multiply continually ſo many times by 10 as there are figures in the multiplier, ſave one; then multiply the given price by the right-hand figure of the multiplier; and again, the firſt product of 10 by the following figure of the multiplier; and ſo on, till you have multiplied by all the figures in the multiplier. The ſum of theſe products is the anſwer.

Examp. III. What is the price of 8604 yards of cloth, at 19 s. $6\frac{1}{2}$d. *per* yard?

L.	*s.*	*d.*	*Price of*		*L.*	*s.*	*d.*	*Price of*
	19	$6\frac{1}{2}$	1 yd,	$\times 4 =$	3	18	2	4 yds.
		10						
9	15	5	10 yds,	$\times 0 =$				
		10						
97	14	2	100 yds,	$\times 6 =$	586	5		600 yds.
		10						
977	1	8	1000 yds,	$\times 8 =$	7816	13	4	8000 yds.
			Price of 8604 yards,		8406	16	6	

3. If

3. If your multiplier consists of integers and parts, the operation is performed by a cross multiplication of the several parts of the multiplier into all the parts of the multiplicand.

The contents of mason and joiners work are frequently cast up by this kind of multiplication; for understanding of which observe, that

The superficial content of any rectangle is found by multiplying the length into the breadth; and the content of a right-angled triangle is found by multiplying the base into half the perpendicular or height.

The dimensions are usually taken in lineal feet, inches, and lines; and the operation is performed by the following rules.

I. Any lineal measure multiplied into the same lineal measure produces squares of that name. Thus, lineal feet multiplied into lineal feet produce square feet; lineal inches into lineal inches produce square inches, *&c.*

II. Lineal feet into lineal inches produce rectangles 1 foot long and 1 inch broad, which divided by 12 quote square feet: and the remainder multiplied by 12, produces square inches.

III. Lineal feet into lineal lines produce rectangles 1 foot long and 1 line broad, which divided by 144 quote square feet; and the remainders are rectangles equal to square inches.

IV. Lineal inches into lineal lines produce small rectangles 1 inch long and 1 line broad, which divided by 12 quote square inches; and the remainder, multiplied by 12, produces square lines.

Examp. I. In an area, pavement, or piece of plaister-work, in length 24 feet 7 inches, and in breadth 18 feet 5 inches, how many square feet?

F.	*in.*
24	7
18	5
432	35
20	72
452	107

18×7=126
24×5=120
12)246(20
24
12×6=72 — by Rule II.

Here multiply 18 lineal feet into 24 lineal feet, and the product is 432 square feet; then multiply 5 lineal inches into 7 lineal inches, and the product is 35 square inches, by Rule I.; then multiply 18 lineal feet into 7 lineal inches, and the product is 126; and again multiply 24 lineal feet into 5 lineal inches, and the product is 120; which added to the former product, gives 246 rectangles, each being 1 foot in length and one inch in breadth; these divided by 12 quote 20 square feet; and the remainder 6 multiplied by 12, produces 72 square inches, according to Rule II.; these add to the former square feet and inches, and you'll find the answer or total product to be 452 square feet, and 107 square inches.

Examp. II. In an area or floor, in length 38 feet 9 inches 6 lines, and in breadth 23 feet 8 inches 6 lines, how many square feet?

F.	*in.*	*li.*
38	9	6
23	8	6
874	72	36
42	84	
2	78	
	8	72
919	98	108

23×9=207
38×8=304
12)511(42
48
31
24
12×7=84 — By Rule II.

38×6=228
23×6=138
144)366(2
288
78 — By Rule III.

8×6=48
9×6=54
12)102(8
96
12×6=72 — By Rule IV.

Because the sum of the inches exceeds 144, carry 1 from them to the column of feet, and set down the overplus, *viz.* 98.

The operation may be rendered easier and shorter by previously reducing the factors to two denominations, *viz.* inches and lines. Thus the former example may be proposed and wrought as follows.

In an area or floor, in length 465 inches 6 lines, and in breadth 284 inches 6 lines, how many square inches and feet?

Inch.	*lin.*
465	6
284	6
132060	36
374	72
132434	108

465×6=2790
284×6=1704
12)4494(374 *in.*
12×6=72 *li.* — By Rule IV.

The answer here is 132434 square inches, and 108 square lines; and if the inches be divided by 144, you will have 919 square feet and a remainder of 98 square inches, as before.

Or the factors may be reduced to the lowest denomination, *viz.* lines, and then the product will be square lines, which, divided by 144, will quote square inches, and the remainder will be square lines; and the square inches, divided by 144, will quote square feet, and the remainder will be square inches. Again, the square feet, divided by 9, will quote square yards, and the remainder will be square feet; and the square yards, divided by 36, will quote square roods, and the remainder will be square yards.

If this cross multiplication be extended to the mensuration of solids, the content of which is found by multiplying the superficial content of the base into the height, depth, length, or thickness, the operation must be conducted by the following rules.

V. Any superficial measure multiplied into the same lineal measure produces a solid of the same name. Thus superficial feet multiplied into lineal feet produce solid feet; superficial inches multiplied into lineal inches produce solid inches, *&c.*

VI.

VI. Superficial feet into lineal inches produce parallelopipeds, whose base is 1 square foot, and their height 1 inch; which divided by 12 quote solid feet; and the remainder, multiplied by 144, produces solid inches.

VII. Superficial feet into lineal lines produce parallelopipeds, whose base is 1 square foot, and their height 1 line; which divided by 144 quote solid feet; and the remainder multiplied by 12 produces solid inches.

VIII. Superficial inches into lineal lines produce parallelopipeds, whose base is 1 square inch, and their height 1 line; which divided by 12 quote solid inches; and the remainder multiplied by 12 produces solid inches.

IX. Lineal feet into superficial inches produce parallelopipeds, whose base is one square inch, and their height 1 foot; which divided by 144 quote solid feet; and the remainder multiplied by 12 produces solid lines.

X. Lineal feet into superficial lines produce parallelopipeds, whose base is 1 square line, and their height 1 foot; which divided by 12 quote solid inches; and the remainder multiplied by 144 produces solid lines.

XI. Lineal inches into superficial lines produce parallelopipeds, whose base is 1 square line, and their height 1 inch; which divided by 144 quote solid inches; and the remainder multiplied by 12 produces solid lines.

Examp. III. In a piece of timber, whose length is 18 feet 16 inches, breadth 2 feet 4 inches, and thickness 2 feet 3 inches, how many solid feet?

F.	in.		
18	6	2×6=12	
2	4	18×4=72	by Rule II.
36	24	12)84(7 F.	
7			43×3=129; 12)129(10 F.; 144×9=1296 in. — by Rule VI.
43	24	superficial	
2	3	lineal	2×24=48; 12×48=576 in. — by R. IX.
86	72		
10	1296		
	576		
97	216	solid	

Here first multiply 18 feet 6 inches into 2 feet 4 inches, as formerly, and the product is 43 feet 24 inches superficial; which next multiply into 2 feet 3 inches lineal, thus, 43 superficial feet into 2 lineal feet produce 86 solid feet, and 24 superficial inches into 3 lineal inches produce 72 solid inches, by Rule V.; then 43 superficial feet into 3 lineal inches produce 129 parallelopipeds, whose base is 1 square foot, and their height 1 inch; which divided by 12 quotes 10 solid feet; and the remainder 9 multiplied into 144 produces 1296 solid inches, by Rule VI. Again, 2 lineal feet into 24 superficial inches produce 48; which, being less than 144, you esteem a remainder, and multiplying it into 12 you have a product of 576 solid inches, by Rule IX.

Because the sum of the inches exceeds 1728, carry 1 from thence to the feet, and the overplus 216 set down.

Examp. IV. How many solid feet in a polished stone, that is 8 feet 9 inches 5 lines long, 7 feet 3 inches broad, and 3 feet 5 lines thick?

F.	in.	l.		
8	9	5	7×9=63; 8×3=24	
7	3		12)87(7 F.	by Rule II.
56	27		12×3=36 in.	
7	36		7×5=35 in. by Rule III.	
	35		3×5=15	
	1	36	12)15(1 in.	by Rule IV.
63	99	36	sup. 12×3=36 li.	
3		5	lin.	
189		180	63×5=315, and 144)315(2 F.; 12×27=324 in.	by R. VII.
[illegible]	124			
2	108		3×99=297, and 144)297(2 F.; 12×9=108 in.	by R. IX.
	9		3×36=108, and 12)108(9 in.	by Rule X.
	41	432	5×99=495, and 12)495(41 in.; 144×3=432 lines.	by R. VIII.
193	482	612		

The operation may be facilitated by previously reducing the three factors to two denominations, *viz.* inches and lines, as was done in Example II. on superficial measure.

Or the three factors may be reduced to the lowest denomination, *viz.* lines, which being multiplied continually, will produce solid lines; which divided by 1728, will quote solid inches, the remainder being solid lines; and the solid inches divided by 1728 will quote solid feet, the remainder being solid inches; and the solid feet divided by 27 will quote solid yards, the remainder being solid feet; and the solid yards divided by 216 will quote solid roods; the remainder being solid yards.

We shall only further observe, that as the rules for working questions by cross multiplication are numerous, and the operation tedious, it is easier to convert the parts into a decimal fraction of their integer, and then work as taught in the multiplication of decimals.

III. *The Proof of Multiplication.*

Multiplication may be proved several ways, *viz.* by multiplication, by division, and by casting out the 9's.

1. By multiplication: Change the places of the factors, and make that the multiplier which before was the multiplicand; and if the work be right, you will have the same product as before; but this method is tedious.

2. By division: When the work is right, the product divided by the multiplier quotes the multiplicand; or, divided by the multiplicand, quotes the multiplier. But this supposes the learner acquainted with division.

3. The most usual method therefore of proving multiplication is by casting out the 9's; which is done thus: Cast the 9's out of the multiplicand and multiplier, and place the excesses on the right and left sides of a cross; multiply these two figures into one another, casting the 9's out of their product, if need be, and place the excess at the top of the cross; then casting the 9's also out of the product of your multiplication, place its excess at the bottom;

bottom; and if the work be right, the figures at top and bottom will agree, or be the same.

754	
38	
6032	
2262	
28652	

$$\begin{array}{ccc} & 5 & \\ 2 & \times & 7 \\ & 5 & \end{array}$$

Examp. I. Here cast the 9's out of the multiplicand, and place the excess 7 on the right side of the cross; then cast the 9's out of the multiplier, and place the excess 2 on the left side of the cross; next multiply these excesses 2 and 7 into one another, cast the 9's out of their product, and place the excess five at the top of the cross; lastly, cast the 9's out of the product, and place the excess 5 at the foot of the cross; which being the same with the figure at the top, you may conclude the work to be right.

L.	*s.*	*d.*
43	8	$4\frac{1}{4}$
		8
347	6	10

$$\begin{array}{ccc} & 7 & \\ 8 & \times & 2 \\ & 7 & \end{array}$$

Examp. II. Here, in casting the 9's out of the multiplicand, and out of the product, begin with the pounds, and reduce the excess to shillings, and in like manner the excess of the shillings is reduced to pence, and that of the pence to farthings. The multiplier being an abstract number, needs no reduction; but if a multiplier be a mixt number, or consist of integers and parts, as feet and inches, *&c.* the excess of the higher denomination must always be reduced to the lower.

Chap. V. Division.

Division discovers how often one number is contained in another: or,

Division, from two numbers given, finds a third, which contains unity as often as the one given number contains the other.

The number to be divided, or which contains the other, is called the *dividend*; the number by which we divide, or which is contained in the dividend, is called the *divisor*; and the number found by division, or which expresses how often the dividend contains the divisor, is called the *quotient* or *quot.*

$$\begin{array}{r} 18 \\ 6 \\ \hline 12 \\ 6 \\ \hline 6 \\ 6 \\ \hline (0) \end{array}$$

As multiplication supplies the place of many additions, so division, which is the reverse of multiplication, serves instead of many subtractions; as will thus appear: Suppose it were required to divide 18 by 6, that is, to find how often 6 is contained in 18, the work by subtraction will stand as in the margin: by which it appears, that 6 is contained 3 times in the number 18. But this, by division, may be found at one trial: thus,

$$\begin{array}{l} 6)18(3 \\ \;\;\;18 \\ \;\;\;\overline{\;\;\;} \\ \;\;\;(0) \end{array}$$

Set the divisor on the left of the dividend, leaving room on the right hand for the quotient, as in the margin; and then say, How often 6 in 18? *Ans.* 3 times: this 3 set in the quotient; then multiply the quotient figure 3 into the divisor 6, saying, 3 times 6 make 18; which set down below the dividend, and subtract it from the dividend, and o remains.

I. *Division of Integers.*

Rule I. From the left-hand part of the dividend point off the first dividual, *viz.* so many figures as will contain the divisor.

II. Ask how often the divisor is contained in the dividual, and put the answer in the quotient.

III. Multiply the divisor by the figure set in the quotient, and subtract the product from the dividual.

IV. To the right of the remainder bring down the next figure of the dividend for a new dividual; and then proceed as before.

Divisor.	Dividend.	Quotient.
7)	875(	125
	...	
	7	
	17	
	14	
	35	
	35	
	(0)	

Examp. I. Here, because the divisor 7 is contained in 8, the left-hand figure of the dividend, point it off as the first dividual, according to Rule I; and then say, How often 7 in 8? *Ans.* 1 time; which 1 set in the quotient, as directed in Rule II.; then multiply the divisor 7 by this quotient figure 1, and subtract the product 7 from the dividual 8, as directed in Rule III.; to the remainder 1 bring down the following figure of the dividend, for the second dividual, as directed in Rule IV.; then proceed as before, and say, How often 7 in 17? *Ans.* 2 times; wherefore, setting two in the quotient, multiply and subtract and find the next remainder to be 3; to which bring down the following figure of the dividend, and you have 35 for the third dividual; then say, How often 7 in 35? *Ans.* 5 times; which 5 being placed in the quotient, multiply and subtract, and o remains; so the quotient is 125.

By reviewing the steps of the preceding operation, and reducing the dividuals and quotient-figures to their separate values, the reason of the rules will be obvious; for,

	7)875(	100	partial quots.
		20	
1st dividual	800		
	700		
rem.	100	125	total quot.
add	70		
2d dividual	170		
	140		
rem.	30		
add	5		
3d dividual	35		
	35		
	(0)		

The separate value of the first dividual 8 is 800; and the separate value of 1, the first figure put in the quot, is 100; for as 8 contains 7 the divisor 1 time, so 800 contains it 100 times, and 100 remains; to which bring down the following figure of the dividend 7, whose separate value is 70; and the second dividual is 170; and as 7 is contained 2 times in 17, so it is contained 20 times in 170, and 30 remains; to which bring down the next or last figure of the dividend 5; and the third dividual

is

is 35, in which the divisor 7 is contained 5 times. Now it is evident, that the sum of the partial quots, 125, is the total quot, or a number expressing how often the dividend 875 contains the divisor 7.

From the above example we may learn, that there are always just so many figures in the quotient as there are dividuals; or the first dividual, with the number of subsequent figures in the dividend, is equal to the number of places or figures in the quotient.

Hence likewise may be inferred, that no divisor is contained in any dividual oftener than 9 times; for the dividual, excluding the right-hand figure, is always less than the divisor by 1 at least; and if both be multiplied by 10, or have a cipher annexed to each of them, the product of the dividual will be less than the product of the divisor by 10 at least; but no right-hand figure can supply this defect of 10; therefore the divisor is not contained 10 times in any dividual, and consequently not oftener than 9 times.

Here too observe, that the right-hand figure of the first dividual, and all the subsequent figures of the dividend, have a point or dot set below them, as they are brought down; which is done to prevent mistakes, by distinguishing them, in this manner, from the figures not yet brought down.

$8)56032897(7004112\frac{1}{8}$ numer. / denom.

```
8)56032897(7004112 1/8
   ......
  56
  ---
  ·032
    32
   ---
    ·8
     8
    --
    ·9
     8
    --
    17
    16
    --
    (1)
```

Examp. II. Here, because 8 is not contained in 5, point off 56 as the first dividual, and say, How often 8 in 56? *Ans.* 7; which put in the quotient; then multiply 7 into the divisor 8, and subtract the product 56 from the dividual; and as nothing remains, bring down the next figure of the dividend, which happens to be a cipher; and as you cannot have 8 in 0, put 0 in the quotient; and, as multiplying and subtracting is in this case needless, you bring down the next figure of the dividend 3; and as you cannot have 8 in 3, put another 0 in the quotient, and bring down the next figure of the dividend 2: Then say, How often 8 in 32? *Ans.* 4; which put in the quotient: Then multiply and subtract; and as nothing remains, bring down the next figure of the dividend 8, and say, How often 8 in 8? *Ans.* 1; which put in the quotient: then multiply and subtract; and as nothing remains, bring down the next figure of the dividend 9, and say, How often 8 in 9? *Ans.* 1; which put in the quotient: then multiply and subtract; and to the remainder 1 bring down the next and last figure of the dividend 7, and say, How often 8 in 17? *Ans.* 2; which put in the quotient: then multiply and subtract, and 1 remains.

To complete the quotient, draw a line on the right hand, and set the remainder above the line, and the divisor 8 below it, signifying that 1 remains to be divided by 8; or this part of the quotient may be considered as a fraction, whose numerator is 1, and its denominator 8; and the quotient thus completed shews, that the dividend contains the divisor 7004112 times, and one eighth part of a time.

Here observe, that not only the last remainder, but every other remainder, must be less than the divisor; for if it be either greater or equal, the divisor might have been oftener got, and the quotient-figure is too little. And should any one in this case attempt to continue the operation, the quotient-figures would be all 9's, the dividuals would prove inexhaustible, and the remainders would constantly increase.

Hence also learn, that if any dividual happen to be less than the divisor, you must put 0 in the quotient, and bring down the next figure of the dividend; and if it be still less than the divisor, you must put another 0 in the quotient, and bring down the following figure of the dividend, &c.

```
36)789426(21928 18/36
     .....
   72
   --
   69
   36
   --
   334
   324
   ---
    102
     72
    ---
    306
    288
    ---
    (18)
```

III. Here the divisor consists of two figures; and because it is contained in the two left-hand figures of the dividend 78, point them off as the first dividual; and say, How often 3 in 7? *Ans.* 2, and 1 remains; which 1 placed, or conceived as placed, on the left hand of the following figure 8, makes 18: then say, Can I have the following figure of the divisor 6 also 2 times in 18? *Ans.* Yes; consequently I get 36 the divisor 2 times in 78 the dividual; wherefore put 2 in the quotient, and multiply that 2 into the divisor 36, and subtract the product 72 from the dividual 78; and to the remainder 6 bring down the following figure of the dividend 9, for a new dividual: then say, How often 3 in 6? *Ans.* 2, and 0 remains; again you say, Can I have 6 also 2 times in 9? *Ans.* No; therefore you can have 36 in 69 only 1 time, which 1 you put in the quotient: then multiply and subtract as before; and to the remainder 33 bring down the next figure 4 for a new dividual: Then, because the dividual consists of a figure more than the divisor, say, How often the first figure of the divisor 3 in the first two figures of the dividual 33? *Ans.* 9, and 6 remains; which 6 placed on the left hand of the following figure 4 makes 64: Again, say, Can I have 6 also 9 times in 64? *Ans.* Yes; consequently 36 can be had 9 times in 334; wherefore you put 9 in the quotient: Then multiply and subtract; and to the remainder 10 bring down the next figure 2 for a new dividual: Here likewise, because the dividual has a figure more than the divisor, say, How often 3 in 10? *Ans.* 3, and 1 remains; which 1 placed on the left hand of the following figure 2 makes 12: Again say, Can I have 6 also 3 times in 12? *Ans.* No; consequently 36 cannot be had 3 times in 102; wherefore try if you

you can have it 2 times; ſaying, 2 times 3 is 6 from 10, and 4 remains; which 4 placed on the left hand of the next figure 2 makes 42: And again ſay, Can I have 6 alſo 2 times in 42? *Anſ.* Yes; conſequently 36 can be had 2 times in 102; accordingly put 2 in the quotient, multiply and ſubtract; and to the remainder 30 bring down the next and laſt figure of the dividend 6, for a new dividual: Then, becauſe the dividual has a figure more than the diviſor, ſay, How often 3 in 30? *Anſ.* 9, and 3 remains; which 3 placed on the left hand of the following figure 6 make 36: And again ſay, Can I have 6 alſo 9 times in 36? *Anſ.* No; conſequently 36 cannot be had 9 times in 306; therefore try if it can be had 8 times, ſaying, 8 times 3 is 24 from 30, and 6 remains; which 6 placed on the left hand of the following figure 6 makes 66: Again ſay, Can I have 6 alſo 8 times in 66? *Anſ.* Yes; conſequently 36 can be had 8 times in 306; wherefore put 8 in the quotient, and multiply and ſubtract as before: The laſt remainder 18 is the numerator of a fraction, and the diviſor its denominator, to be annexed to the integral part of the quotient; as was taught in the former example.

The preceding operation points out the manner of procedure when the diviſor conſiſts of more figures than one, *viz.* you muſt take the firſt figure of the diviſor out of the firſt figure of the dividual, or out of the firſt two figures of the dividual in caſe the dividual have a figure more than the diviſor: Then imagine the remainder to be prefixed to the next figure of the dividual, and try if you can have the ſecond figure of the diviſor as often out of this number; if you can, imagine again the remainder to be prefixed to the following figure of the dividual, and try if you can have the third figure of the diviſor as often out of this number, *&c.*; but if you find you cannot have ſome ſubſequent figure of the diviſor ſo often as you took the firſt, you muſt go back, and take the firſt figure of the diviſor 1 time leſs, or ſome number of times leſs out of the firſt, or out of the firſt two figures of the dividual: Then proceed as before, repeating the trial till you find you have the ſecond and all the ſubſequent figures of the diviſor as often as you took the firſt.

But here obſerve, that if, in trying how often the diviſor can be had in the dividual, either 9, or a number greater than 9, any where remain, you may conclude, without further trial, that all the ſubſequent figures of the diviſor can be had as often as you took the firſt; as may be thus demonſtrated.

Suppoſe the ſubſequent figures of the diviſor to be the higheſt poſſible, that is, all 9's, and the following figures of the dividual the loweſt poſſible, that is, all 0's; again, imagine the remainder 9 prefixed to the following figure of the dividual 0, that it will make 90; now it is plain, that the ſubſequent figure of the diviſor 9 can be had in 90, the higheſt number of times poſſible, *viz.* 9 times, and 9 will remain; which prefixed to the next figure of the dividual 0, makes 90, in which the ſubſequent figure of the diviſor 9 can again be had 9 times, and 9 will remain as before; therefore all the ſubſequent figures of the diviſor can be had as often as you took the firſt; and if they can be had in this caſe, much more can they be had when a number greater than 9 remains.

IV. If, as in the margin, a cipher or ciphers, poſſeſs the right hand of the diviſor, cut them off, and cut off as many figures, *viz.* in this example, the figure 2 from the right hand of the dividend; then divide the remaining figures of the dividend, *viz.* 89678, by the remaining figures of the diviſor, *viz.* 648, and you have the integral part of the quotient; but to the remainder 254 annex the figure cut off from the dividend, and you have 2542 for the numerator of your fraction, and the whole diviſor 6480 is the denominator.

```
648|0)89678|2(138 2542/6480
        ...
      648
      ----
      2487
      1944
      ----
       5438
       5184
       ----
      (2542)
```

The reaſon will appear obvious by working a queſtion in this manner, and alſo at full length, without cutting off the cipher or ciphers, and then comparing the two operations.

V. If, as in the margin, the figures cut off from the right hand of the dividend, happen to be all ciphers; in this caſe, the laſt remainder, without regarding the ciphers cut off, is the numerator of your fraction, and the ſignificant figures of the diviſor the denominator. The reaſon is aſſigned in the doctrine of fractions.

```
48|00)9780|00(203 36/48
        ....
        96
        ---
         180
         144
         ---
        (36)
```

In like manner, if there be cut off from the dividend any number of ſignificant figures, with a cipher or ciphers on their right hand; in this caſe the laſt remainder, with the ſignificant figures cut off, make the numerator of your fraction; and the ſignificant figures of the diviſor, with as many ciphers as the number of ſignificant figures cut off from the dividend, make the denominator. Thus, if, in the above example, the figures cut off from the dividend had been 50, the numerator of your fraction would have been 365, and the denominator 480.

Contractions in working Diviſion of Integers.

1. To divide any number by 10, 100, 1000, *&c.* you have only to point off for a remainder as many figures on the right hand of the dividend as the diviſor has ciphers, and the other figures on the left of the point or ſeparatrix are the quotient. Thus, 7489634 divided by 10, 100, 1000, *&c.* ſtands as follows.

```
       Quot  rem.
   10)748963.4
  100)74896.34
 1000)7489.634
10000)748.9634
```

2. If the figures of the diviſor are all 9's, or all except the units figure, as 9, 99, 999, 98, 997, 9996, *&c.* work as follows:

Find a new diviſor, by annexing to unity as many ciphers as there are figures in the given diviſor, ſubtract the given from the new diviſor, and the remainder or difference is the complement. Divide the given dividend by the new diviſor, *viz.* point off ſo many figures on the

the right hand as there are ciphers in the ſaid diviſor; the figures thus pointed off are to be eſteemed a remainder, and the other figures on the left hand are to be accounted a quotient; then multiply this quotient by the complement, placing the units of the product under the units of the former remainder; again, divide this product by the new diviſor, by pointing off from the right hand the ſame number of figures as in the former remainder, and the figures to the left are to be eſtemmed another quotient; which quotient you are again to multiply by the complement, and divide as before. And in this manner proceed till the laſt quotient is nothing; then add as in addition of integers, obſerving the carriage from the left hand column of the remainders; to the remainders add the product of the ſaid carriage and complement, and the ſum is the total remainder; and the ſum of the ſeveral quotients is the total quotient required.

EXAMPLE.

Divide 74678 by 98.

```
New diviſor    100        100)746.98
Given diviſor   98            14.92=746×2
                ——              .28=14×2
Complement       2           ———————
        Tot. quot. 762.18+4=22 total rem.
Carriage 2×2 complement=4
```

EXPLICATION.

Firſt, to unity annex two ciphers, becauſe the given diviſor conſiſts of two figures, and ſo the new diviſor is 100; from which ſubtract the given diviſor 98, and there remains 2 for the complement.

Next divide the given dividend by the new diviſor, *viz.* point off 98, the two figures next the right hand, for the firſt remainder; and the figures on the left, namely, 746, is the quotient.

Then multiply the ſaid firſt quotient 746 by the complement 2; and by the new diviſor divide the product 1492, *viz.* point off 92 for the ſecond remainder, and 14 is the ſecond quotient.

Again, multiply the ſecond quotient 14 by the complement 2, and the product 28, divided by 100, gives 28 for the third remainder, but nothing to the quotient.

Then add the ſeveral remainders and quotients, and find the total quotient amounts to 762, and the remainders to 18.

Laſtly, multiply 2, the carriage from the left-hand column of the remainders, by the complement 2; and the product 4 add to the remainders 18, and the ſum 22 is the total remainder.

II. *Diviſion of the parts of Integers.*

HERE there are three caſes.

1. If the diviſor be a digit, by it divide the integers of the dividend, reduce the remainder to the parts of the next inferior denomination, and add it, when thus reduced, [illegible] parts; then divide the ſum, reducing and adding the remainder to the parts of the following denomination, *&c.*

Note, If the integral part of the dividend be leſs than the diviſor, you muſt, in the firſt place, reduce it to the parts of the next denomination.

EXAMP. I. If L. 274 : 13 : 8 : 3 be equally divided among 8 men, what will each man's ſhare be?

Here firſt divide the integers L. 274 by 8, and the quotient is L. 34, and L. 2 remains; which reduced to the next denomination makes 40 ſhillings; and theſe added to 13 ſhillings make 53 ſhillings; which divided by 8 gives 6 ſhillings to the quotient, and 5 ſhillings remains; which 5 ſhillings reduced make 60d. and 60d. added to 8d. make 68 d.; which divided by 8 gives 8 d. to the quotient, and 4 d. remains, *&c.*

```
     L.   s.  d.  f.
  8)274   13  8   3    dividend.
     34    6  8   2⅜   quotient.
```

The operation may, if you pleaſe, be drawn out at large; as in the following

EXAMP. II. If C. 42 : 2 : 8 of tobacco be made up into 5 equal hhds, what will be the neat weight of each hhd?

Here divide the C. 43 by 5, and the quotient is C. 8, and C. 3 remains; which reduced, and added to the 2 Q. makes 14 Q. which divide by 5, *&c.*

```
   C.  Q.  lb.   C.  Q.  lb.
  5)43  2   8  ( 8   2   24
    40
    ——
     3 rem.
     4
    ——
    14
    10
    ——
     4 rem.
    28
   ———
   120
   10
   ———
    20
    20
    ——
    (0)
```

2. If the diviſor conſiſts of two or more figures, and be a compoſite number, reſolve it into its component parts, and divide the given dividend by one of theſe parts, the quotient by another, *&c.* and the laſt quotient is the anſwer.

3. If the diviſor conſiſts of integers and parts, reduce both diviſor and dividend to the ſame denomination, and then proceed as in diviſion of integers.

III. *The Proof of Diviſion.*

DIVISION may be proved ſeveral ways, *viz.* by multiplication, by diviſion, and by caſting out the 9's.

1. By multiplication: Multiply the quotient by the diviſor, or the diviſor by the quotient; and the product with the remainder added to it, will be equal to the dividend: Or, take the products of the quotient-figures into the diviſor, add them in the order they ſtand under the dividuals; and their ſum, with the remainder, will be equal to the dividend.

2. By diviſion: Divide the difference of the dividend and remainder by the quotient, and your next quotient will be equal to your firſt diviſor, without any remainder. But this method is tedious.

3. By caſting out the 9's: Caſt the 9's out of the diviſor

visor and quotient, place the excesses on the right and left sides of a cross; then multiply these two figures into one another, and cast the 9's out of their product; add the excess to the remainder; and, casting out the 9's if need be, place the sum or excess at the top of the cross; then cast the 9's out of the dividend, and set the excess at the bottom. If the work be right, the figures at the top and bottom of the cross will agree, or be the same.

These methods of proof are a proper exercise to the learner in schools; but, in business, the only proof used is a careful revisal of the operation.

Chap. VI. Reduction.

Reduction teacheth how to bring a number of one name or denomination to another of the same value; and is either descending, ascending, or mixt.

I. Reduction descending brings a number of a higher denomination to a lower, when the lower is some aliquot part of the higher; as pounds to shillings, pence, or farthings; and is performed by multiplication.

II. Reduction ascending brings a number of a lower denomination to a higher, when the lower is some aliquot part of the higher; as shillings, pence, or farthings, to pounds; and is performed by division.

III. Mixt reduction brings a number of one denomination to another, when the one is no aliquot part of the other; as pounds to guineas, and requires the use of both multiplication and division.

In treating of reduction we shall conjoin the descending and ascending, the one serving as a proof of the other; and shall afterwards treat of mixt reduction by itself.

In working reduction, of whatever kind, the following rule is to be observed, *viz.*

Multiply or divide as the tables of money and weights direct.

Reduction descending and ascending.

1. MONEY.

Quest. 1. In L. 472 how many shillings, pence, and farthings?

This reduction is descending, therefore multiply the pounds by 20, because 20 shillings make 1 pound, and the product is shillings: then multiply the shillings by 12, because 12 pence make 1 shilling, and the product is pence: lastly, multiply the pence by 4, because 4 farthings make 1 penny, and the product is farthings.

```
   472  pounds.
    20
  ----
  9440  shillings.
    12
  ----
  1888
  944
------
113280  pence.
     4
------
453120  farthings.
```

Proof by Reduction ascending.

In 453120 farthings how many pence, shillings, and pounds?

Here divide the farthings by 4, because 4 farthings make 1 penny, and the quotient is pence: then divide the pence by 12, because 12 pence make 1 shilling, and the quotient is shillings: lastly, divide the shillings by 20, because 20 shillings make 1 pound, and the quotient is pounds.

```
  4)453120  farthings.
   -------
 12)113280  pence.
   -------
 2|0)944|0  shillings.
   ------
     472    pounds.
```

Note 1. To reduce pounds to pence at one operation, multiply by 240, the number of pence in 1 pound.

Note 2. To reduce pounds to farthings at one operation, multiply by 960, the number of farthings in 1 pound.

Note 3. To reduce shillings to farthings at one operation, multiply by 48, the number of farthings in 1 shilling.

Note 4. To reduce pence to pounds at one operation, divide by 240, the pence in 1 pound.

Note 5. To reduce farthings to pounds at one operation, divide by 960, the farthings in 1 pound.

Note 6. To reduce farthings to shillings at one operation, divide by 48, the farthings in 1 shilling.

Here follows the farthings of Quest. 1. reduced back to pounds by these notes.

By note 4.

```
      4)453120  farthings.
       -------
 24|0)11328|0 d. (472 L.
        ..
       96
       ---
       172
       168
       ---
        48
        48
        --
        (0)
```

By note 5.

```
 96|0)45312|0(472 L.
       384..
       ----
        691
        672
        ---
        192
        192
        ---
        (0)
```

By note 6.

```
              2|0)
 48)453120(94 |0  shillings.
    ...  -----
    432     472   pounds.
    ---
     211
     192
     ---
      192
      192
      ---
      (0)
```

2. AVOIRDUPOIS WEIGHT.

Quest. 1. In C. 47 : 1 : 20 how many ounces?

```
 C.  Q.  lb.
 47   1   20
  4
 ---
189 Q.
 28
----
1512
380
----
5312 lb.
  16
-----
31872
5312
-----
84992 oz.
```

P R O O F.

In 84992 ounces how many lb. Q. and C.

```
          28)    4)    C.  Q.  lb.
16(84992 (5312 (189 (47   1   20
   80...   28..  16
   ---     ---   ---
    49     251   29
    48     224   28
   ---     ---   ---
    19     272   (0) Q.
    16     252
   ---     ---
    32    (20) lb.
    32
   ---
   (0)
```

Mixt Reduction.

In working mixt reduction observe the following

Rule. By reduction descending bring the given name to some such third name as is an aliquot part both of the name given and of the name sought, and then by reduction ascending bring the third name to the name sought.

Mixt reduction, as well as reduction descending and ascending, extends to money, as follows.

Quest. In 764 l. how many guineas?

Here the given name is pounds, the name sought is guineas, and the third name, to which the pounds are reduced, is shillings; for a shilling is an aliquot part both of a pound and of a guinea.

```
    764 pounds.
     20
   ------
21)15280(727 guineas.
   147..
   ---
     58
     42
    ---
    160
    147
    ---
   (13) shillings.
```

P R O O F.

In 727 guineas 13 shillings, how many pounds?

```
 Guineas. shill.
   727     13
    21
   ---
   730
  1455
  -----
2|0)1528|0
  -----
   764 pounds.
```

Chap. VII. The Rule of Three.

The Rule of Three, called also, on account of its excellence, the *Golden Rule*, from certain numbers given finds another; and is divided into simple and compound, or into single and double.

Sect. I. *The Simple or Single Rule of Three.*

The simple rule of three, from three numbers given, finds a fourth, to which the third bears the same proportion as the first does to the second.

The nature and properties of proportional numbers may be understood sufficiently for our purpose from the following observations.

In comparing any two numbers, with respect to the proportion which the one bears to the other, the first number, or that which bears proportion, is called the *antecedent*; and the other, to which it bears proportion, is called the *consequent*; and the quantity of the proportion or ratio is estimated from the quot arising from dividing the antecedent by the consequent. Thus the ratio or proportion betwixt 6 and 3 is the quot arising from dividing the antecedent 6 by the consequent 3; namely, 2; and the ratio or proportion betwixt 1 and 2 is the quot arising from the division of the antecedent 1 by the consequent 2; namely $\frac{1}{2}$, or one half.

Four numbers are said to be proportional when the ratio of the first to the second is the same as that of the third to the fourth; and the proportional numbers are usually distinguished from one another as in the following examples.

$4 : 2 :: 16 : 8 \qquad 6 : 9 :: 12 : 18.$

Proportional numbers, or numbers in proportion, are usually denominated *terms*; of which the first and last are called *extremes*, and the intermediate ones get the name of *means*, or *middle terms*.

If four numbers are proportional, they will also be inversely proportional; that is, the first consequent will be to its own antecedent as the second consequent is to its antecedent; or the fourth term will be to the third as the second is to the first. Thus, if 6 : 3 :: 10 : 5, then by inversion, 3 : 6 :: 5 : 10, or 5 : 10 :: 3 : 6. *Euclid* v. 4. cor. By either of these kinds of inversion may any question in the rule of three be proved.

If four numbers are proportional, they will also be alternately proportional; that is, the first antecedent will be

be to the ſecond antecedent as the firſt conſequent is to the ſecond conſequent; or the firſt term will be to the third term as the ſecond term is to the fourth. Thus, if 8 : 4 :: 24 : 12, then, by alternation, 8 : 24 :: 4 : 12. *Euclid* v. 16.

But the celebrated property of four proportional numbers is, that the product of the extremes is equal to the product of the means. Thus, if 2 : 3 :: 6 : 9, then $2 \times 9 = 3 \times 6 = 18$. *Euclid* vi. 16.

Hence we have an eaſy method of finding a fourth proportional to three numbers given, *viz.*

Multiply the middle number by the laſt, and divide the product by the firſt, the quot gives the fourth proportional.

Examp. Given 6, 5, and 36, to find a fourth proportional; put x equal to the fourth proportional, then $6 : 5 :: 36 : x$, and $5 \times 36 = 180 = 6 \times x$; wherefore, dividing the product 180 by the factor 6, the quot gives the other factor x, namely 30, the fourth proportional ſought.

Every queſtion in the rule of three may be divided into two parts, *viz.* a ſuppoſition and a demand; and of the three given numbers, two are always found in the ſuppoſition, and only one in the demand.

Examp. If 4 yards coſt 12 ſhillings, what will 6 yards coſt at that rate?

In this queſtion the ſuppoſition is, If 4 yards coſt 12 ſhillings; and the two terms contained in it are 4 yards and 12 ſhillings: The demand lies in theſe words, What will 6 yards coſt? and the only term found in it is 6 yards.

The ſuppoſition and demand being thus diſtinguiſhed, proceed to ſtate the queſtion, or to put the terms in due order for operation, as the following rules direct.

Rule I. Place that term of the ſuppoſition, which is of the ſame kind with the number ſought, in the middle. The two remaining terms are extremes, and always of the ſame kind.

II. Conſider, from the nature of the queſtion, whether the anſwer muſt be greater or leſs than the middle term; and if the anſwer muſt be greater, the leaſt extreme is the diviſor; but if the anſwer muſt be leſs than the middle term, the greateſt extreme is the diviſor.

III. Place the diviſor on the left hand, and the other extreme on the right; then multiply the ſecond and third terms, and divide their product by the firſt; and the quot gives the anſwer; which is always of the ſame name with the middle term.

When the diviſor happens to be the extreme found in the ſuppoſition, the proportion is called *direct*; but when the diviſor happens to be the extreme in the demand, the proportion is *inverſe*.

The three rules delivered above are indeed ſo framed, as to preclude the diſtinction of direct and inverſe, or render it needleſs; the left-hand term being always the diviſor; but yet the direct queſtions being plainer in their own nature, and more eaſily comprehended by a learner, we ſhall, in the firſt place, exemplify the rules by a ſet of queſtions of the direct kind, and ſhall afterwards adduce an example or two of ſuch as are inverſe.

I. *The Simple Rule of Three Direct.*

Quest. 1. If 4 yards coſt 12 ſhillings, what will 6 yards coſt at that rate?

The ſuppoſition and demand of this queſtion have already been diſtinguiſhed, and the two terms in the former are 4 yards 12 ſhillings, and the only term in the latter is 6 yards.

The number ſought is the price of ſix yards, and the term in the ſuppoſition of the ſame kind is the price of 4 yards, *viz.* 12 ſhillings, which place in the middle, as directed in Rule I. and the two remaining terms are extremes, and of the ſame kind, *viz.* both lengths.

It is eaſy to perceive that the anſwer muſt be greater than the middle term; for 6 yards will coſt more than 4 yards; therefore the leaſt extreme, *viz.* 4 yards, is the diviſor, according to Rule II.

Yds. *s.* *yds.*
If 4 : 12 :: 6
6
4)72(18 ſhillings *Anſ.*
4
32
32
(0)

Wherefore place the diviſor 4 yards on the left hand, and the other extreme 6 yards on the right; and multiplying the ſecond and third terms, divide their product by the firſt term, and the quot 18 is the anſwer, and of the ſame name with the middle term, *viz.* ſhillings, according to Rule III.

And becauſe the diviſor is the extreme found in the ſuppoſition, the proportion is direct.

Quest. 2. If 7 C. of pepper coſt 21 l. how much will 5 C. coſt at that rate?

The ſuppoſition in this queſtion is, that 7 C. of pepper coſts 21 l. and the two terms in it are 7 C. and 21 l.; the demand is, How much will 5 C. coſt? and the term in it is 5 C.

The number ſought is the price of 5 C. and the term in the ſuppoſition of the ſame kind is the price of 7 C. *viz.* 21 l. which place in the middle. The two remaining terms are extremes, and of the ſame kind, *viz.* quantities of pepper.

It is obvious, that the anſwer muſt be leſs than the middle term; for 5 C. will coſt leſs than 7 C.; and therefore the greateſt extreme, *viz.* 7 C. is the diviſor.

C. *L.* *C.*
If 7 : 21 :: 5
5
7)105(15 *l.* *Anſ.*
7
35
35
(0)

Accordingly place the diviſor 7 C. on the left hand, and the other extreme 5 C. on the right; and having multiplied the ſecond and third terms, divide their product by

by the firſt term, and the quot 15 is the anſwer, of the ſame name with the middle term, *viz.* L. Sterling.

And becauſe the diviſor happens to be the extreme in the ſuppoſition, the proportion is direct.

QUEST. 3. If 13 yards of velvet coſt L. 21, what will 27 yards coſt at that rate?

Y. L. Y.
If 13 : 21 :: 27
27
———
147
42
———
13)567(43 L.
52
———
47
39
———
Rem. 8 L.
20
———
13)160(12 s.
13
———
30
26
———
* Rem. 4 s.

* Rem. 4 s.
12
—
13)48(3 d.
39
—
Rem. 9 d.
4
—
13)36(2 f.
26
—
Rem. 10 f.

L. s. d. f.
Anſ. 43 12 3 $2\frac{10}{13}$

When there happens to be a remainder, it may be reduced to the next inferior denomination, and the operation continued, as in the margin; and in this caſe the quot will conſiſt of two or more parts.

* Rem. 4 s.

Such remainders are always of the ſame name with the preceding part of the quot. Thus, the firſt remainder 8, and the firſt part of the quot 43, are both pounds; and the ſecond remainder 4, and the ſecond part of the quot 12, are both ſhillings; and the third remainder 9, and the third part of the quot 3, are both pence; and the fourth remainder 10, and the fourth part of the quot 2, are both farthings.

As we have no money under farthings, the laſt remainder cannot be reduced any lower; ſo there remains 10 farthings to be divided by 13; that is, there is wanting to complete the quot, the thirteenth part of 10 farthings, or the thirteenth part of every remaining farthing; that is, ten thirteenth parts of one farthing; ſo you ſet the remainder 10 above, and the diviſor 13 below a line drawn between them, in the form of a fraction, of which the remainder is the numerator, and the diviſor the denominator.

II. *The Simple Rule of Three Inverſe.*

QUEST. 1. If 8 men can do a piece of work in 12 days, in how many days will 16 men do the ſame?

In this queſtion the ſuppoſition is, If 8 men do a piece of work in 12 days, and the two terms contained in it are 8 men and 12 days: The demand lies in theſe words, In how many days will 16 men do the ſame? and the only term contained in it is 16 men.

The number ſought here is the days in which 16 men will do the work, and the term in the ſuppoſition of the ſame kind is 12 days; wherefore I place 12 days as the middle term, according to Rule I. the two remaining terms are extremes, and of the ſame kind, *viz.* both of them men.

It is obvious that the anſwer muſt be leſs than the middle term; for 16 men will do the work in fewer days than 8 men; and therefore, by Rule II. the greateſt extreme, *viz.* 16, is the diviſor; which place on the left hand, and the other extreme on the right, as directed in Rule III. Then multiplying the ſecond and third, and dividing their product by the firſt, the quot comes out in days; that is, of the ſame name with the middle term.

Men. days. men.
16 : 12 :: 8
8
—
16)96(6 days. *Anſ.*
96
—
(0)

And becauſe the extreme found in the demand happens to be the diviſor, the proportion is inverſe.

Queſt. 2. How much pluſh of 3 quarters wide will line a cloak that hath in it 4 yards of 7 quarters wide?

Here the anſwer muſt be greater than the middle term; for the pluſh being narrower than the cloth of which the cloak is made, will require more length.

Q. yds. Q.
3 : 4 :: 7
7
—
3) 28 ($9\frac{1}{3}$ yards. *Anſ.*
27
—
(1)

Queſt. 3. If 36 yards be a rood of maſon-work, at 3 feet high, how many yards will make a rood at 9 feet high?

Feet. yds. feet.
9 : 36 :: 3
3
—
9) 108
—
Anſ. 12 yards.

SECT. II. *The Compound Rule of Three.*

THE Compound Rule of Three, from five given numbers finds a ſixth, or from ſeven given numbers finds an eighth, or from eleven finds a twelfth, *&c.*

This rule eaſily and naturally admits of ſubdiviſions, which, from the number of the terms given, may be denominated the rule of Five, the rule of Seven, the rule of Nine, the rule of Eleven, *&c.*

Queſtions in the Compound rule of three are alſo reſolved into two parts, *viz.* a ſuppoſition and a demand.

If five terms be given, three of theſe are always found in the ſuppoſition, and two in the demand; if ſeven terms be given, four of theſe are in the ſuppoſition, and three in the demand; if nine terms are given, five of theſe are in the ſuppoſition, and four in the demand; if eleven terms be given, ſix of theſe are in the ſuppoſition, and five in the demand, *&c.*

The ſuppoſition and demand being diſtinguiſhed, proceed to ſtate the queſtion; that is, to put the terms in due order for operation, as the following rules direct.

RULE I. Place that term of the ſuppoſition which is of the ſame kind with the number ſought, in the middle.

The

The remaining terms are extremes, which must be classed into similar pairs, by making each pair consist of one term taken from the supposition, and another of the same kind taken from the demand.

II. Out of each similar pair, joined with the middle term, form a simple question; and in each simple question, so formed, find the divisor; *viz.* consider from the nature of the question, whether the answer must be greater or less than the middle term; and if the answer must be greater, the least extreme is the divisor; but if the answer must be less than the middle term, the greatest extreme is the divisor.

III. Place all the divisors on the left hand, and the other extremes on the right; then multiply the divisors, or extremes on the left, continually, for a divisor, and multiply the extremes on the right hand and the middle term, continually, for a dividend; and, lastly, divide the dividend by the divisor; and the quot is the answer, of the same name with the middle term.

The answer to questions in the compound rule of three may also be had by working the simple questions separately, or by themselves, in the following manner, *viz.*

The middle term, with any one pair of similar extremes, make the first simple question, and the answer to this question must be made the middle term to the next similar pair of extremes; and the answer to this second question, must in like manner be made the middle term to the following similar pair of extremes, *&c.*; and the answer to the last simple question is the number sought.

But the joint operation prescribed in Rule III. is the shorter as well as the easier method; for in working some of the simple questions, there may happen to be a remainder, and consequently the middle term of the next simple question will have some fractional part; which inconveniency is avoided by working jointly.

In every simple question, when the divisor is an extreme found in the supposition, the proportion is direct; but when the divisor is an extreme found in the demand, the proportion is inverse.

The three rules delivered above are indeed so calculated, as to make no difference between direct and inverse, or so as to render that distinction needless, the left-hand extremes being all divisors; but yet, as questions consisting entirely of direct proportions are the plainest and easiest, it will be proper, in the first place, to exemplify the rules by questions of the direct kind, and afterwards introduce such as are inverse.

And as questions in the rule of five are by far more numerous, and occur much oftener, than questions in the rule of seven, nine, or eleven; we shall, first of all, give questions in the rule of five, wherein both proportions are direct; then those wherein one or both proportions are inverse; and, lastly, give a few examples of the rules of seven, nine, and eleven.

I. *The Rule of Five Direct.*

QUEST. I. If 14 horses eat 56 bushels of corn in 16 days, how many bushels will 20 horses eat in 24 days?

The supposition in this question is, If 14 horses eat 56 bushels in 16 days; and the three terms contained in it are, 14 horses, 56 bushels, and 16 days: The demand is, How many bushels will 20 horses eat in 24 days? and the two terms contained in it are 20 horses, and 24 days.

The number sought is bushels, and the term in the supposition of the same kind is 56 bushels; wherefore, according to Rule I. place 56 bushels in the middle. The remaining four terms are extremes, which you class into similar pairs, by making each pair consist of one term taken from the supposition, and another of the same kind taken from the demand. Thus, 14 horses, and 20 horses make one pair; again, 16 days, and 24 days make another pair.

Out of the several similar pairs, joined with the middle term, you form so many simple questions, according to Rule II. *viz.* by saying,

1. If 14 horses eat 56 bushels in a certain number of days, how many bushels will 20 horses eat in the same time?

2. If 16 days eat up, or consume, 56, or any other number of bushels, how many bushels will 24 days consume?

In the first simple question it is obvious, that the answer will be greater than the middle term; for 20 horses will eat more bushels than 14 horses will do in the same time; and so the least extreme, *viz.* 14, is the divisor; and because 14 is an extreme found in the supposition, the proportion is direct.

In the second simple question it is also plain, that the answer will be greater than the middle term; for 24 days will consume more bushels than 16 days; and consequently the least extreme, *viz.* 16, is the divisor; and because 16 is an extreme found in the supposition, the proportion is direct.

According to Rule III. place the divisors on the left hand, and the other extremes on the right, and both of them under one another, so that the two upper ones make a pair, or be of one kind, and the two lower ones make another pair, or be of one kind; and no matter which of the pairs be uppermost: then multiply the divisors, or the extremes on the left hand, for a divisor; and again multiply the extremes on the right, and the middle term, continually, for a dividend; and dividing the dividend by the divisor, the quot or answer comes out of the same name with the middle term, *viz.* 120 bushels.

Joint operation.

```
Horses. bushels. horses.
If 14  :  56  :  :  20
da.16             24 da.
   ---            ---
   84             480
   14              56
   ---            ---
   224            288
                  240
                 -----
          224)26880(120
                224
                ---
                448
                448
                ---
                (0)
```

Ans. 120 bushels.

The

The two ſimple queſtions into which the compound queſtion is reſolved, are ſtated, and wrought ſeparately, as follows.

```
   H.  B.    H.  Days. B.    Days.
If 14 : 56 : : 20  If 16 : 80 : : 24
        20                       80
      -----                    -----
  14)1120(80 B.           16)1920(120 B.
     112                     16
     ----                    ---
     (o)                      32
                              32
                              ---
Anſ. 120 buſhels, as before.  (o)
```

II. *The Rule of Five Inverſe.*

The queſtions that fall under this rule have commonly one of the proportions inverſe, and the other direct, and ſometimes the upper, and ſometimes the lower, is the inverſe proportion; and in ſome few queſtions both proportions are inverſe. Now, though the three rules delivered above make no difference betwixt direct and inverſe; yet, to bring the learner to ſome meaſure of acquaintance with this uſeful diſtinction, we ſhall, in ſtating the following queſtions, expoſe the ſame to view, by affixing an aſteriſk to the extremes of every inverſe proportion.

Queſt. If 14 horſes eat 56 buſhels of corn in 16 days, in how many days will 20 horſes eat 120 buſhels at that rate?

In this queſtion the ſuppoſition is, that 14 horſes eat 56 buſhels in 16 days; and the demand is, In how many days 20 horſes will eat 120 buſhels.

The number ſought is days, and the term in the ſuppoſition of the ſame kind is 16 days; and accordingly place 16 days in the middle. The remaining four terms are extremes; which claſs into ſimilar pairs, by making each pair conſiſt of one term taken from the ſuppoſition, and another of the ſame kind taken from the demand. Thus, 14 horſes and 20 horſes make one pair; again, 56 buſhels and 120 buſhels make another pair.

Out of the ſimilar pairs, joined with the middle term, form ſo many ſimple queſtions; namely,

1. If 14 horſes eat a certain number of buſhels in 16 days, in how many days will 20 horſes eat the ſame quantity?

2. If 56 buſhels are eat up in 16 days, in how many days will 120 buſhels be eat up by the ſame eaters?

In the firſt ſimple queſtion it is plain, that the anſwer muſt be leſs than the middle term; for 20 horſes will eat the ſame number of buſhels in fewer days than 14 horſes; and ſo the greateſt extreme, *viz.* 20, is the diviſor; and becauſe 20 is an extreme found in the demand, the proportion is inverſe.

In the ſecond ſimple queſtion it is alſo obvious, that the anſwer muſt be greater than the middle term; for 120 buſhels will require more days to be eat up in than 56 buſhels; and therefore the leaſt extreme, *viz* 56, is the diviſor; and becauſe 56 is an extreme found in the ſuppoſition, the proportion is direct.

We now proceed to ſtate the queſtion, by placing the diviſors on the left hand, and the other extremes on the right; then multiply and divide, as directed in Rule III. and the anſwer comes out of the ſame name with the middle term, *viz.* 24 days.

Joint operation.

```
        Horſ. days.  horſ.
        *20 : 16 : : 14*
bush. 56              120 bush.
     -----            -----
     1120             1680
                        16
                      -----
                      1008
                      168
                      ------- days.
          112|o)2688|o(24 An.
                224
                ----
                 448
                 448
                 ---
                 (o)
```

The two ſimple queſtions into which the compound queſtion is reſolved, are ſtated and wrought ſeparately, as follows.

```
Horſ. day.  horſ.        Buſh. d.  h.  m.    buſh.
*20 : 16 : : 14*         56 : 11—4—48 : : 120
      14                       24
      --                       --
      64                       48
     16                        22
     ---                       --
2|o)22|4 (11 days.            268
      24                        60
     9|6(4 hours.             -----
      ---                    16128
      16                       120
       60                    ------ 6|o)
      ---                 56(1935360(3456|o
    96|o(48 min.             168....------
                             ---   24)576(24 days.
                             255     48
                             224     --
                             ---      96
                              313     96
                              280     --
                              ---    (o)
                              336
                              336
                              ---
                              (o)
```

III. *The Rule of Seven, Nine,* &c.

Quest. If 15 men eat 156 d. worth of bread in 6 days, when wheat is ſold at 12 s. *per* buſhel, in how many days will 30 men eat 520 d. worth of bread when wheat is at 10 s. *per* buſhel?

This queſtion belongs to the rule of ſeven, the number ſought is days, and the term of the ſame kind in the ſuppoſition is 6 days, which place in the middle. The remaining ſix terms are extremes, which claſs into ſimilar pairs, by taking one term of each pair out of the ſuppoſition, and another of the ſame kind out of the demand.

Out

Out of the ſimilar pairs, joined with the middle term, form ſo many ſimple queſtions, in each of which you find the diviſor by Rule II.; then place the diviſors on the left hand, and the other extremes on the right, as directed in Rule III. and multiply and divide, as follows.

Joint operation.

```
            Men. days. men.
   s.       * 30 : 6 : : 15 *      s.
* 10 : d. 156              520 d. : 12 *
          ----             ----
          4680               30
            10               75
          -----            ----
          46800            7800
                             12
                           -----
                           93600
                               6
                           -----
        468|00)5616|00(12 days. Anſ.
               468
               ---
               936
               936
               ---
               (0)
```

This compound queſtion is reſolved into three ſimple ones, as follows.

```
 30 :  6 : :  15 :  3
156 :  3 : : 520 : 10
 10 : 10 : :  12 : 12 days. Anſ.
```

Examp. If 100 lb. of Venice weigh 70 lb. of Lyons, and 120 lb. of Lyons weigh 100 lb. of Roan, and 80 lb. of Roan weigh 100 lb. of Touloufe, and 100 lb. of Toulouſe weigh 74 lb. of Geneva, how many pounds of Geneva will 100 lb. of Venice weigh?

This queſtion belongs to the rule of nine; and becauſe pounds of Geneva is the number ſought, the given pounds of Geneva, *viz.* 74, muſt be the middle term: the remaining terms are extremes; which may be claſſed into ſimilar pairs, and ſtated as follows.

```
                   Tol. Gen. Tol.
Ven. Ly.           100 : 74 : : 100        Ly. Ven.
100 : 120 : Roan 80          100 Roan : 70 : 100
                 ----        -----
                 8000        10000
                  120           70
                 ------      ------
                 960000      700000
                    100         100
                 --------    --------
                 96000000    70000000
                                   74
                 ---------------------
96|000000)5180|000000(53 92/96 lb of Geneva. Anſ.
          480
          ---
          380
          288
          ---
          (92)
```

But the queſtion becomes more ſimple, and is wrought with greater eaſe and advantage, by being ſtated in the fractional form, as follows.

$$\frac{100\times70\times100\times100\times74}{100\times120\times80\times100}=\frac{70\times100\times74}{120\times80}=$$

$$\frac{7\times10\times74}{12\times8}=\frac{5180}{96}=53\tfrac{92}{96}\text{ lb. of Geneva. } \textit{Anſ.}$$

We ſhall conclude by obſerving, that every compound queſtion, whether in the rule of five, ſeven, nine, or eleven, *&c.* properly ſpeaking, conſiſts but of three given terms. For the firſt term, or diviſor, is to be conſidered as one compound term made up, or produced, by the continual multiplication of the extremes on the left hand, as ſo many component parts. In like manner, the third term is to be conſidered as one compound term, made up by the continual multiplication of the extremes on the right, as component parts. Suppoſe the queſtion to be,

If L. 100 in 12 months gain L. 5 intereſt, what will L. 75 gain in 19 months?

Here it is obvious, that it is neither the L. 100 principal, nor the 12 months of time, taken ſeparately, that gains the L. 5 intereſt, but both contribute their ſhare; that is, they conſpire, as joint cauſes, to produce one effect; and therefore their product, *viz.* the firſt term, is to be conſidered as the cauſe producing the effect; that is, the firſt term, *viz.* 100 × 12, cauſeth, produceth, or gains L. 5 of intereſt. And in like manner, the product of the extremes on the right hand, or the third term, *viz.* 75 × 9, is to be eſteemed the cauſe that produceth a ſimilar effect; that is, gains a like ſum of intereſt, namely, the fourth term, or anſwer. In reference to this way of conſidering the firſt and third terms, the queſtion might be ſtated as under.

If 100 × 12 : 5 : : 75 × 9

Chap. VIII. Fellowship.

Fellowship, called alſo *Company*, or *Partnerſhip*, is when two or more perſons join their ſtocks, and trade together, dividing the gain or loſs proportionally among the partners.

Fellowſhip is either without or with time, called alſo *Single* or *Double*.

I. *Fellowſhip without time.*

Queſtions in fellowſhip without time are wrought by the following proportion.

As the total ſtock
To the total gain or loſs,
So each man's particular ſtock
To his ſhare of the gain or loſs.

Queſt. A and B make a joint ſtock: A puts in 12 l. and B 8 l.; they gain 5 l.: What is each man's ſhare?

L.

	L.		Stock, gain. Stock.
A's stock	12		A. If 20 : 5 :: 12
B's stock	8		5
	—		—
Total stock	20		2|0)6|0
			—
			A's gain 3 l.

Stock. gain. Stock.
B. If 20 : 5 :: 8
8
—
2|0)4|0
—
B's gain 2 l.

	L.
A's gain	3
B's gain	3
	—
Total gain	5 proof.

Note 1. When in any question there happen to be remainders, they must be reduced equally low, so as to be all of one name; and then their sum will be either equal to the divisor, or exactly double, triple, *&c.* of it: and accordingly 1, 2, 3, *&c.* carried from the sum of the remainders, and added to the particular gains, will make up the total gain; or the divisor will always divide the sum of the remainders exactly, and the quot added to the particular gains will give the total gain.

Note 2. When the partners have equal shares of stock or capital, their shares of gain, loss, or neat proceeds, is found readily by dividing the total gain, loss, *&c.* by the number of partners.

II. *Fellowship with time.*

In fellowship with time, the gain or loss is divided among the partners, both in proportion to the stocks themselves, and also in proportion to the times of their continuance in company: For the same stock continued a double time, procures a double share of gain; and continued a triple time, procures a triple share of gain; that is, the shares of gain or loss are as the products of the several stocks multiplied into their respective times: and accordingly questions belonging to this rule are wrought by the following proportion.

As the sum of the products of the several stocks into their respective times
To the total gain or loss,
So the product of each man's stock into his time
To his share of the gain or loss.

Quest. 1. A put into company 40 l. for 3 months, B 75 l. for 4 months; they gain 70 l.: What share must each man have?

A 40×3=120, third term for A's share.
B 75×4=300, third term for B's share.
———
420, first term.

L.	L.
A. If 420 : 70 :: 120	B. If 420 : 70 :: 300
120	300
—	—
42|0)840|0(20 l.	42|0)2100|0(50 l.
84	210
—	—
(0)	(0)

	L.
A's gain	20
B's gain	50
	—
Total gain	70 proof.

Quest. 2. A put into company 560 l. for 8 months, B 279 l. for 10 months, and C 735 l. for 6 months; they gained 1000 l.: What share of the gain must each have?

A 560× 8=4480, third term for A's share.
B 279×10=2790, third term for B's share.
C 735× 6=4410, third term for C's share.
———
11680, first term.

	L.		L.	s.	d.	f.	Rem.
A If 11680 :	1000 ::	4480 :	383—	11—	2—	3—	208
B If 11680 :	1000 ::	2790 :	238—	17—	4—	3—	80
C If 11680 :	1000 ::	4410 :	377—	11—	4—	1—	880
		Proof	1000—	00—	0—	0—	1168

Chap. IX. Vulgar Fractions.

A Fraction is a part or parts of an unit, or of any integer or whole; and is expressed by two numbers, one above and the other below a line drawn between them; as, $\frac{1}{2}$.

The number under the line shews into how many parts the unit or integer is divided; and is called the *denominator*, because it gives name to the fraction: The number above the line shews or tells how many of these parts the fraction contains; and is therefore called the *numerator*.

In the fraction $\frac{3}{4}$ l. a pound Sterling is the unit, integer, or whole; and the denominator 4 shews that the pound is broken or divided into four equal parts, *viz.* 4 crowns; and the numerator 3 shews that the fraction contains three of these parts, that is, three crowns; and so the value of this fraction is fifteen shillings.

Cor. 1. Hence it follows, 1. When the numerator of a fraction is less than the denominator, the value of such a fraction is less than unity, or the integer. 2. When the numerator is equal to the denominator, the value of the fraction is exactly an unit or integer. 3. When the numerator is greater than the denominator, the value of the fraction is more than an unit; and so often as the denominator is contained in the numerator, so many units or wholes are contained in the fraction. If, therefore the numerator of a fraction be divided by the denominator, the quot will be a number of units or integers, and the remainder so many parts.

The numerator of a fraction is to be considered as a dividend, and the denominator as a divisor; and the fraction itself may be taken to denote the quotient.

Cor. 2. From this view of a fraction, it is evident, that if the numerator and denominator of a fraction be either both multipled or both divided by the same number, the products or quotients will retain the same proportion to one another; and consequently the new fraction thence arising will be of the same value with the given one. Thus the numerator and denominator of the fraction $\frac{2}{4}$ multiplied by 2 produces $\frac{4}{8}$, and divided by 2 quots $\frac{1}{2}$, both which fractions are of the same value with $\frac{2}{4}$.

Fractions having 10, 100, 1000, or 1, with any number of ciphers annexed to it, for a denominator, are called

ed *decimal fractions*; and fractions having any other denominator are called *vulgar fractions*.

1. A proper fraction is that whose numerator is less than its denominator, and consequently is in value less than unity; as $\frac{2}{3}$.

2. An improper fraction is that whose numerator is equal to or greater than its denominator; and consequently is in value equal to or greater than an unit; as $\frac{4}{4}$, $\frac{7}{5}$.

3. A simple fraction is that which has but one numerator, and one denominator; and may be either proper or improper; as $\frac{5}{8}$ or $\frac{9}{7}$.

4. A compound fraction is made up of two or more simple fractions, coupled together with the particle *of*, and is a fraction of a fraction; as $\frac{2}{3}$ of $\frac{3}{4}$, or $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$.

5. A mixt number consists of an integer, and a fraction joined with it; as $7\frac{3}{4}$.

Because in most cases fractions can neither be added nor subtracted, till they be reduced, we begin with reduction.

Reduction of Vulgar Fractions.

PROBLEM I. To reduce an improper fraction to an integer, or mixt number.

RULE. Divide the numerator by the denominator, the quot gives integers; and the remainder, if there be any, placed over the divisor or denominator, gives the fraction to be annexed.

EXAMPLES.

1. $\frac{595}{7} = 85$ integers, there being no remainder.
2. $\frac{437}{8} = 54\frac{5}{8}$, the remainder being 5.
3. $\frac{1382}{14} = 98\frac{10}{14}$, the remainder being 10.
4. $\frac{23576}{136} = 173\,\frac{48}{136}$, the remainder being 48.

PROB. II. To reduce a mixt number to an improper fraction.

RULE. Multiply the integer by the denominator; to the product add the numerator: The sum is the numerator of the improper fraction; and the denominator is the same as before.

EXAMPLES.

1. $54\frac{5}{8} = \frac{437}{8}$; for $54 \times 8 = 432$
$+5$

Numerator 437

2. $98\frac{10}{14} = \frac{1382}{14}$; for $98 \times 14 = 1372$
$+10$

Numerator 1382

PROB. III. To reduce a whole number to a fraction of a given denominator.

RULE. Multiply the whole number by the given denominator; and place the product by way of numerator over the given denominator.

EXAMPLES.

1. Reduce 9 to a fraction whose denomination is 5.
$9 \times 5 = 45$; so the fraction is $\frac{45}{5}$.
2. Reduce 36 to a fraction whose denominator is 4.
$36 \times 4 = 144$; so the fraction is $\frac{144}{4}$.
3. Reduce 8 to a fraction whose denominator is 1.
$8 \times 1 = 8$; so the fraction is $\frac{8}{1}$.

The reason of the rule appears by reversing the operation; for if the numerator be divided by the denominator, it will quot the integer, or whole number.

PROB. IV. To reduce a compound fraction to a simple one.

RULE. Multiply the numerators continually for the numerator of the simple fraction; and multiply the denominators continually for its denominator.

EXAMPLES.

Ex. 1. $\frac{2}{3}$ of $\frac{4}{5} = \frac{8}{15}$. *Ex.* 2. $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4} = \frac{6}{24}$.

COR. From this problem may be deduced a method of reducing a fraction of a lesser denomination to a fraction of a greater denomination; namely,

Form a compound fraction, by comparing the given fraction with the superior denominations; and then reduce the compound fraction to a simple one.

EXAMPLES.

1. What fraction of a pound Sterling is $\frac{3}{4}$ of a penny?
$\frac{3}{4}$ d. is $\frac{3}{4}$ of $\frac{1}{12}$ of $\frac{1}{20}$ L. $= \frac{3}{960}$ L.
2. What fraction of a C. is $\frac{7}{8}$ of a pound?
$\frac{7}{8}$ lb. is $\frac{7}{8}$ of $\frac{1}{28}$ of $\frac{1}{4}$ C. $= \frac{7}{896}$ C.

PROB. V. To reduce a fraction of a greater denomination to a fraction of a lesser denomination.

RULE. Multiply the numerator of the given fraction, as in reduction of integers descending; and the product is the numerator, to be placed over the denominator of the given fraction.

EXAMPLES.

1. What fraction of a shilling is $\frac{3}{4}$ of a pound?

Here, as in reduction descending, multiply the numerator 3 by 20, because 20 shillings make a pound; as under.

$$\frac{\overset{L.}{3} \times 20}{4} = \frac{60}{4} \text{ shilling.}$$

2. What fraction of a penny is $\frac{4}{5}$ L.?

$$\frac{\overset{L.}{4} \times 20 \times 12}{5} = \frac{960}{5} \text{ d.}$$

The reason of this rule will appear by observing, that every fraction may be considered in two views. Thus, $\frac{3}{4}$ may either be considered as expressing three fourths of one unit, or as denoting the fourth part of three units. Now, if the unit be a pound Sterling, the fraction, in the latter view, will denote the fourth part of three pounds; and by reducing the numerator L. 3 to shillings, we have $\frac{60}{4}$ s; and again reducing 60 shillings to pence, we have $\frac{720}{4}$ d. equal to $\frac{60}{4}$ s. or to $\frac{3}{4}$ L.

PROB. VI. To find the value of a fraction.

RULE. Reduce the numerator to the next inferior denomination; divide by the denominator; and the quot, if nothing remain, is the value complete.

If there be any remainder, it is the numerator of a fraction whose denominator is the divisor. This fraction may either be annexed to the quotient, or reduced to value, if there be any lower denomination.

EXAMP.

Examp. What is the value of $\frac{3}{4}$ L.?

```
 3
20
--
4)60(15 s.
4
--
20
20
--
(0)
L.  s.
3/4 = 15
```

Here consider $\frac{3}{4}$ L. as expressing the fourth part of three pounds Sterling; so reduce L 3, the numerator, to shillings, and divide by the denominator 4; and as nothing remains, the quot, *viz.* 15 shillings, is the value complete.

The reason of this rule is the same with that in the preceeding problem. It is by the practice of this problem that remainders in the rule of three are reduced to value.

Prob. VII. To reduce a fraction to its lowest terms.

Rule. Divide both numerator and denominator by their greatest common divisor; the two quots make the new fraction.

The greatest common divisor of the numerator and denominator of a fraction is found by the following

Rule. Divide the greater of these two numbers by the lesser; and again divide the divisor by the remainder; and so on, continually, till 0 remains. The last divisor is their greatest common divisor.

Examp. Reduce $\frac{784}{952}$ to its lowest terms.

First find the greatest common divisor of the numerator and denominator, as follows

```
784)952(1
    784
    ---
    168)784(4
        672
        ---
        112)168(1
            112
            ---
Greatest common divisor 56)112(2
                           112
                           ---
                           (0)
```

Then proceed to reduce the given fraction to its lowest terms, by dividing both numerator and denominator by 56, the greast common divisor.

```
56)784(14 new num.      56)952(17 new denom.
   56                      56
   ---                     ---
   224                     392
   224                     392
   ---                     ---
   (0)                     (0)
```

So $\frac{784}{952} = \frac{14}{17}$.

Prob. VIII. To reduce fractions of different denominators to a common denominator.

Rule. Multiply the denominators continually for the common denominator; and multiply each numerator into all the denominators, except its own, for the several numerators.

Examples.

Reduce $\frac{3}{4}$ and $\frac{4}{5}$ to a common denominator.

$4 \times 5 = 20$, the common denominator.
$3 \times 5 = 15$, the first numerator.
$4 \times 4 = 16$, the second numerator.

So the new fractions are $\frac{15}{20}$ and $\frac{16}{20}$.

When the denominator of one fraction happens to be an aliquot part of the denominator of another fraction, the former may be reduced to the same denominator with the latter, by multiplying both its numerator and denominator by the number which denotes how often the lesser denominator is contained in the greater.

Thus, $\frac{2}{3} + \frac{5}{12} = \frac{8}{12} + \frac{5}{12}$.

Here 3 is contained in 12 four times; so multiply both 2 and 3 by 4, and you have $\frac{8}{12} = \frac{2}{3}$.

Again, $\frac{1}{2} + \frac{3}{4} + \frac{5}{8} = \frac{4}{8} + \frac{6}{8} + \frac{5}{8}$.

Sometimes too, the fraction that has the greater denominator may, in like manner, be reduced to the same denominator with that which has the lesser, by division.

Thus, $\frac{3}{9} + \frac{2}{3} = \frac{1}{3} + \frac{2}{3}$.

And $\frac{16}{48} + \frac{9}{36} + \frac{7}{12} = \frac{4}{12} + \frac{3}{12} + \frac{7}{12}$.

The reason of the above rule for reducing fractions to a common denominator is evident from Corollary II.; for both numerator and denominator of every fraction are multiplied by the same number, or by the same numbers.

After fractions are reduced to a common denominator, they may frequently be reduced to lower terms, by dividing all the numerators, and also the common denominator, by any divisor that leaves no remainder, or by cutting off an equal number of ciphers from both.

Addition of Vulgar Fractions.

Rule I. If the given fractions have all the same denominator, add the numerators, and place the sum over the denominator.

Ex. 1. What is the sum of $\frac{2}{7} + \frac{3}{7}$? *Ans.* $\frac{5}{7}$.

2. What is the sum of $\frac{3}{15} + \frac{6}{15}$? *Ans.* $\frac{9}{15} = \frac{3}{5}$, by Prob. VII.

Rule II. If the given fractions have different denominators, reduce them to a common denominator, by Prob. VIII. then add the numerators, and place the sum over the common denominator.

Ex. What is the sum of $\frac{2}{5} + \frac{3}{8}$?

$\frac{2}{5} + \frac{3}{8} = \frac{16}{40} + \frac{15}{40}$, by Prob. VIII.
and $\frac{16}{40} + \frac{15}{40} = \frac{31}{40}$.

Rule III. If mixt numbers be given, or if mixt numbers and fractions be given, reduce the mixt numbers to improper fractions, by Prob. II; then reduce the fractions to a common denominator, by Prob. VIII. and add the numerators.

Ex. What is the sum of $7\frac{3}{4} + 5\frac{2}{3}$?

$7\frac{3}{4} + 5\frac{2}{3} = \frac{31}{4} + \frac{17}{3}$, by Prob. II.
and $\frac{31}{4} + \frac{17}{3} = \frac{93}{12} + \frac{68}{12}$, by Prob. VIII.
and $\frac{93}{12} + \frac{68}{12} = \frac{161}{12} = 13\frac{5}{12}$, by Prob. I.

When mixt numbers, or mixt numbers and fractions, are given, you may, with greater expedition, work by the following rule, *viz.* reduce only the fractions to a common denominator, and add the sum of the fractions to

to the integers. The above example wrought in this manner follows.

Ex. What is the ſum of $7\frac{3}{4}+5\frac{2}{3}$?

$\frac{3}{4}+\frac{2}{3}=\frac{9}{12}+\frac{8}{12}=\frac{17}{12}=1\frac{5}{12}$.

and $7+5+1\frac{5}{12}=13\frac{5}{12}$.

Rule IV. If any, or all of the given fractions, be compound, firſt reduce the compound fractions to ſimple ones, by Prob. IV.; then reduce the ſimple fractions to a common denominator, by Prob. VIII. and add the numerators.

Ex. What is the ſum of $\frac{2}{3}$ of $\frac{4}{5}+\frac{3}{4}$?

$\frac{2}{3}$ of $\frac{4}{5}=\frac{8}{15}$, by Prob. IV.

and $\frac{8}{15}+\frac{3}{4}=\frac{32}{60}+\frac{45}{60}$, by Prob. VIII.

and $\frac{32}{60}+\frac{45}{60}=\frac{77}{60}=1\frac{17}{60}$, by Prob. I.

Rule V. If the given fractions be of different denominations, firſt reduce them to the ſame denomination, by Cor. of Prob. IV. or by Prob. V.; then reduce the fractions, now of one denomination, to a common denominator, by Prob. VIII. and add the numerators; or reduce each of the given fractions ſeparately to value, by Prob. VI. and then add their values.

Ex. What is the ſum of $\frac{3}{4}$s. and $\frac{7}{8}$l.?

Method I.

$\frac{3}{4}$s. $=\frac{3}{4}$ of $\frac{1}{20}$l. $=\frac{3}{80}$l. by Cor. Prob. IV.

and $\frac{3}{80}+\frac{7}{8}=\frac{24}{640}+\frac{560}{640}$, by Prob. VIII.

and $\frac{24}{640}+\frac{560}{640}=\frac{584}{640}$l. $=18$s. 3d. by Prob. VI.

Method II.

$\frac{7}{8}$l. $=\frac{7\times 20}{8}$s. $=\frac{140}{8}$s. by Prob. V.

and $\frac{3}{4}+\frac{140}{8}=\frac{6}{8}+\frac{140}{8}$, by Prob. VIII.

and $\frac{6}{8}+\frac{140}{8}=\frac{146}{8}$s. $=18$s. 3d. by Prob. I. and VI.

Method III.

$$\left.\begin{array}{l} \frac{3}{4}\text{s.}=\frac{3\times 12}{4}\text{d.}=\frac{36}{4}\text{d.}= \quad \overset{\text{d.}}{9} \\ \frac{7}{8}\text{l.}=\frac{7\times 20}{8}\text{s.}=\frac{140}{8}\text{s.}= \overset{\text{s.}}{17—6} \\ \hline \qquad\qquad\qquad\qquad 18—3 \end{array}\right\}\text{by Prob. VI.}$$

Subtraction of Vulgar Fractions.

Rule I. If the given fractions have the ſame denominator, ſubtract the leſſer numerator from the greater, and place the remainder over the denominator.

Ex. From $\frac{5}{7}$ ſubtract $\frac{3}{7}$.

$\frac{5}{7}-\frac{3}{7}=\frac{2}{7}$.

Rule II. If the given fractions have different denominators, reduce them to a common denominator, by Prob. VIII.: then ſubtract the leſſer numerator from the greater, and place the remainder over the common denominator.

Ex. From $\frac{3}{4}$ ſubtract $\frac{2}{3}$.

$\frac{3}{4}$, $\frac{2}{3}=\frac{9}{12}$, $\frac{8}{12}$, by Prob. VIII.

and $\frac{9}{12}-\frac{8}{12}=\frac{1}{12}$.

Rule III. If it be required to ſubtract one mixt number from another, or to ſubtract a fraction from a mixt number, reduce the mixt numbers to improper fractions, by Prob. II; then reduce the fractions to a common denominator, by Prob. VIII. and ſubtract the one numerator from the other.

Ex. From $7\frac{3}{4}$ ſubtract $5\frac{1}{2}$.

$7\frac{3}{4}$, $5\frac{1}{2}=\frac{31}{4}$, $\frac{11}{2}$, by Prob. II.

and $\frac{31}{4}$, $\frac{11}{2}=\frac{62}{8}$, $\frac{44}{8}$, by Prob. VIII.

and $\frac{62}{8}-\frac{44}{8}=\frac{18}{8}=2\frac{2}{8}=2\frac{1}{4}$, by Prob. I. and VII.

Rule IV. If it be required to ſubtract a mixt number, or a fraction, from an integer, firſt ſubtract the fraction from an unit borrowed; that is, ſubtract the numerator from the denominator, and place the remainder, as a numerator, over the denominator, for the fractional part of the anſwer: Then, for the unit borrowed, add 1 to the integral part of the mixt number; ſubtract the ſum from the given integer; and prefix the remainder to the fractional part of the anſwer. But when a fraction is ſubtracted from an integer, for the unit borrowed, take 1 from the given integer, and prefix the remainder to the fractional part of the anſwer.

Ex. 1. From 14 ſubtract $7\frac{3}{5}$.

Here ſay, $5-3=2$; ſo $\frac{2}{5}$ is the fractional part of the anſwer: Then ſay, 1 borrowed and 7 make 8, and 8 ſubtracted from 14 leaves 6; which prefix to the fractional part: So the difference or anſwer is $6\frac{2}{5}$.

Ex. 2. From 12 ſubtract $\frac{3}{7}$.

Here ſay, $7-3=4$; ſo $\frac{4}{7}$ is the fractional part; then ſay, 1 borrowed from 12, and 11 remains: So $11\frac{4}{7}$ is the difference, or anſwer.

Note, When an integer is given to be ſubtracted from a mixt nnmber, you have only to ſubtract the given integer from the integral part of the mixt number; and to the remainder annex the fractional part. Thus, $9\frac{2}{3}-5=4\frac{2}{3}$.

Rule V. If one or both of the given fractions be compound, firſt reduce the compound fractions to ſimple ones, by Prob. IV.; then reduce the ſimple fractions to a common denominator, by Prob. VIII.; and ſubtract the one numerator from the other.

Ex. From $\frac{4}{5}$ ſubtract $\frac{2}{3}$ of $\frac{3}{4}$.

$\frac{2}{3}$ of $\frac{3}{4}=\frac{6}{12}$, by Prob. IV.

and $\frac{4}{5}$, $\frac{6}{12}=\frac{48}{60}$, $\frac{30}{60}$, by Prob. VIII.

and $\frac{48}{60}-\frac{30}{60}=\frac{18}{60}=\frac{3}{10}$, by Prob. VII.

Rule VI. When the given fractions are of different denominations, firſt reduce them to the ſame denomination, by Cor. of Prob. IV. or by Prob. V., then reduce the fractions, now of one denomination, to a common denominator, by Prob. VIII.; and ſubtract the one numerator from the other. Or, reduce each of the given fractions, ſeparately, to value, by Prob. VI.; and ſubtract the one value from the other.

Ex. From $\frac{3}{4}$l. ſubtract $\frac{2}{3}$s.

Method I.

$\frac{2}{3}$s. $=\frac{2}{3}$ of $\frac{1}{20}$l. $=\frac{2}{60}$l. by Cor. Prob. IV.

and $\frac{3}{4}$, $\frac{2}{60}=\frac{180}{240}$, $\frac{8}{240}$, by Prob. VIII.

and $\frac{180}{240}-\frac{8}{240}=\frac{172}{240}$l. $=14$s. 4d. by Prob. I. and VI.

Method II.

$\frac{3}{4}$l. $=\frac{3\times 20}{4}$s. $=\frac{60}{4}$s. by Prob. V.

and $\frac{60}{4}$, $\frac{2}{3}=\frac{180}{12}$, $\frac{8}{12}$, by Prob VIII.

and $\frac{180}{12}-\frac{8}{12}=\frac{172}{12}$s. $=14$s. 4d. by Prob. I. and VI.

Method

METHOD III.

$$\left.\begin{array}{l} \frac{3}{4}\text{l.} = \dfrac{3\times20}{4}\text{s.} = \frac{60}{4}\text{s.} = \\ \frac{2}{3}\text{s.} = \dfrac{2\times12}{3}\text{d.} = \frac{24}{3}\text{d.} = \end{array}\begin{array}{r} \textit{s.}\quad \textit{d.} \\ 15-0 \\ 8 \\ \hline 14-4 \end{array}\right\}\text{by Prob. VI.}$$

Multiplication of Vulgar Fractions.

IN multiplication of fractions there is no occasion to reduce the given fractions to a common denominator, as in addition and subtraction: only if a mixt number be given, reduce it to an improper fraction; if an integer be given, reduce it to an improper fraction, by putting an unit for its denominator; if a compound fraction be given, you may either reduce it to a simple one, or, instead of the particle *of*, insert the sign of multiplication: then work by the following

RULE. Multiply the numerators for the numerator of the product, and multiply the denominators for its denominator.

EXAMP. 1. $\frac{2}{3}\times\frac{4}{5}=\frac{8}{15}$

2. $\frac{3}{4}\times5\frac{2}{3}=\frac{3}{4}\times\frac{17}{3}=\frac{51}{12}=4\frac{3}{12}=4\frac{1}{4}$.

Note 1. If any number be multiplied by a proper fraction, the product will be less than the multiplicand; for multiplication is the taking of the multiplicand as often as the multiplier contains unity; and consequently, if the multiplier be greater than unity, the product will be greater than the multiplicand; if the multiplier be unity, the product will be equal to the multiplicand; and if the multiplier be less than unity, the product will, in the same proportion, be less than the multiplicand. Thus, supposing the multiplier to be $\frac{1}{2}$ or $\frac{1}{3}$, the product, in this case, will be equal to one half or to one third of the multiplicand.

$$\begin{array}{r} 54\frac{1}{4} \\ 24\frac{1}{2} \\ \hline 216 \\ 108 \\ 27 \\ 6 \\ \hline 1329\frac{1}{8} \end{array}$$

2. Mixt numbers may be multiplied without reducing them to improper fractions, by working as in the margin; where first multiply the integral parts, *viz.* 54 by 24; then multiply the integral parts cross-ways into their altern fractions, *viz.* 54 by $\frac{1}{2}$, and the product 27 set down; in like manner multiply 24 by $\frac{1}{4}$, and the product 6 likewise set down; then add; and to the sum annex $\frac{1}{8}$, the product of the two fractions.

3. In multiplying a fraction by an integer, you have only to multiply the numerator by the integer, the putting one for the denominator being only matter of form. And to multiply a fraction by its denominator is to take away the denominator, the product being an integer, the same with, or equal to the numerator. Thus, $\frac{7}{8}\times8=7$. For $\frac{7}{8}\times\frac{8}{1}=\frac{56}{8}=7$.

4. If the numerators and denominators of two equal fractions be multiplied cross-ways, the products will be equal. Thus, if $\frac{3}{9}=\frac{4}{12}$, then will $3\times12=9\times4$; for multiplying both by 9, we have $3=\dfrac{9\times4}{12}$; and multiplying these by 12, we have $3\times12=9\times4$. Hence, if four numbers be proportional, the product of the extremes will be equal to the product of the means: for if $3 : 9 :: 4 : 12$, then $\frac{3}{9}=\frac{4}{12}$; and it has been proved, that $3\times12=9\times4$. Therefore if, of four proportional numbers, any three be given, the fourth may easily be found, *viz.* when one of the extremes is sought, divide the product of the means by the given extreme; and when one of the means is sought, divide the product of the extremes by the given mean.

5. In multiplying fractions, equal factors above and below may be dashed or dropt. Thus, $\frac{1}{2}$ of $\frac{2}{3}\times\frac{3}{4}$ of $\frac{4}{5}=\frac{1}{2}\times\frac{2}{3}\times\frac{3}{4}\times\frac{4}{5}$; and dropping the factors 2, 3, 4, both above and below, the product is $\frac{1}{5}$. In like manner, to facilitate an operation, a factor above and another below may be divided by the same number: Thus, $\frac{6}{7}\times\frac{5}{12}=\frac{1}{7}\times\frac{5}{2}=\dfrac{5}{7\times2}=\frac{5}{14}$. Or we may exchange one numerator for another: Thus, $\frac{6}{7}\times\frac{5}{12}=\frac{6}{12}\times\frac{5}{7}=\frac{1}{2}\times\frac{5}{7}=\frac{5}{14}$.

6. To take any part of a given number, is to multiply the said number by the fraction. Thus, $\frac{5}{8}$ of 320 is found thus, $\frac{5}{8}\times\frac{320}{1}=\frac{5}{1}\times\frac{320}{8}=\frac{5}{1}\times\frac{40}{1}=\frac{200}{1}=200$. In like manner, $\frac{2}{3}$ of $45\frac{3}{8}$, is $\frac{2}{3}\times45\frac{3}{8}=\frac{2}{3}\times\frac{363}{8}=\frac{2}{8}\times\frac{363}{3}=\frac{1}{4}\times\frac{121}{1}=\frac{121}{4}=30\frac{1}{4}$. Hence, to reduce a compound fraction to a simple one, is to multiply the parts of it into one another.

7. If a multiplicand of two or more denominations be given to be multiplied by a fraction, reduce the higher part or parts of the multiplicand to the lowest species, and then multiply. Thus, to multiply 8 l. $10\frac{3}{4}$ s. by $\frac{2}{3}$, say, 8 l. $=8\times20$ s. $=160$ s. and $160+10\frac{3}{4}=170\frac{3}{4}$ s. $=\frac{683}{4}$, and $\frac{2}{3}\times\frac{683}{4}=\frac{1366}{12}=113\frac{10}{12}$ s. = L. 5 : 13 : 10. Or, without reducing, you may multiply the given multiplicand by the numerator of the fraction, and divide the product by the denominator.

EXAMP. 1.	Multiply $\frac{5}{7}$ by $\frac{9}{11}$.	Prod. $\frac{45}{77}$.
2.	Multiply $7\frac{8}{9}$ by $\frac{4}{5}$.	Prod. $6\frac{14}{45}$.
3.	Multiply $8\frac{2}{3}$ by $9\frac{3}{4}$.	Prod. $84\frac{1}{2}$.

The reason of the rule may be shewn thus: $\frac{2}{3}\times\frac{4}{5}=\frac{8}{15}$: for $\frac{4}{5}=\frac{12}{15}$, and $\frac{1}{3}$ of $\frac{12}{15}$ is $\frac{4}{15}$; and consequently $\frac{2}{3}$ of $\frac{12}{15}$ is $\frac{8}{15}$.

The truth of the rule may also be proved thus: Assume two fractions equal to two integers, such as, $\frac{8}{4}$, and $\frac{6}{2}$, equal to 2 and 3, and the product of the fractions will be equal to the product of the integers; for $\frac{8}{4}\times\frac{6}{2}=\frac{48}{8}=6$, and $2\times3=6$.

Division of Vulgar Fractions.

IN division of fractions, if a mixt number be given, reduce it to an improper fraction; if an integer be given, put an unit for its denominator; if a compound fraction be given, reduce it to a simple one, and then work by the following

RULE. Multiply cross-ways, *viz.* the numerator of the divisor into the denominator of the dividend, for the denominator of the quot; and the denominator of the divisor into the numerator of the dividend, for the numerator of the quot.

EXAMP. 1. $\frac{2}{3})\,\frac{4}{5}\,(\frac{12}{10}=1\frac{2}{10}=1\frac{1}{5}$.

2. $\frac{3}{4})\,4\frac{1}{4}\,(=\frac{17}{4})\,\frac{17}{4}\,(\frac{68}{12}=5\frac{8}{12}=5\frac{2}{3}$.

3. $4\frac{2}{3})\,\frac{7}{8}\,(=\frac{14}{3})\,\frac{7}{8}\,(\frac{21}{112}=\frac{3}{16}$.

Note.

Note 1. Inftead of working divifion of fractions as taught above, you may invert the divifor, and then multiply it into the dividend. Thus, in Example 1. inftead $\frac{2}{3})\frac{4}{5}(\frac{12}{10}$, you may fay, $\frac{3}{2}\times\frac{4}{5}=\frac{12}{10}=1\frac{2}{10}=1\frac{1}{5}$.

2. If any number be divided by a proper fraction, the quot will be greater than the dividend: for in divifion the quot fhews how often the divifor is contained in the dividend; and confequently if the divifor be greater than unity, the quot will be lefs than the dividend; if the divifor be unity, the quot will be equal to the dividend; and if the divifor be lefs than unity, the quot will, in the fame proportion, be greater than the dividend. Thus, fuppofing the divifor to be $\frac{1}{2}$, or $\frac{1}{3}$, the quot in this cafe will be double or triple of the dividend.

3. To divide a fraction by an integer, is only to multiply the integer into the denominator of the fraction, the numerator being continued. Thus, $7)\frac{3}{4}(\frac{3}{28}$.

4. A mixt number may fometimes be divided by an integer, with more eafe, in the following manner. Divide the integral part of the mixt number by the given integer: and if there be no remainder, divide likewife the fraction of the mixt number by the given integer, and annex the quot to the integral quot formerly found. But if, in dividing the integral part, there happen to be a remainder, prefix this remainder to the fraction for a new mixt number; which reduce to an improper fraction: then divide the improper fraction by the given integer, and annex the quot to the integral quot formerly found. Thus, if it be required to divide $15\frac{3}{4}$ by 8, fay, 8) 15(1, and 7 remains; which 7, prefixed to the fraction, gives $7\frac{3}{4}$ for a new mixt number; and this, reduced to an improper fraction, is $\frac{31}{4}$, and $8)\frac{31}{4}(\frac{31}{32}$: fo the complete quot is $\frac{31}{32}$.

5. If the factors of the numerator and denominator of the quots, inftead of being actually multiplied, be only connected with the fign of multiplication, it will be eafy to drop fuch factors, above and below, as happen to be the fame, thus: $\frac{3}{4})\frac{4}{5}$ of $\frac{3}{8}\left(\frac{4\times4\times3}{3\times5\times8}=\frac{4\times4}{5\times8}=\frac{16}{40}\right.$ $=\frac{2}{5}$. Or a factor above and below may be divided by the fame number thus: $\frac{5}{6})\frac{7}{12}\left(\frac{6\times7}{5\times12}=\frac{7}{5\times2}=\frac{7}{10}\right.$. Or the factors of the numerator of the quot may be exchanged, thus: $\frac{2}{3})\frac{5}{9}\left(\frac{3\times5}{2\times9}=\frac{5\times3}{2\times9}=\frac{5}{2\times3}=\frac{5}{6}\right.$

6. To divide an integer by a fraction, is to divide the product of the denominator and integer by the numerator, thus: $\frac{4}{5})8\left(=\frac{5\times8}{4}=5\times2=10\right.$.

7. If the divifor and dividend have the fame denominator, you have only to divide the numerator of the dividend by the numerator of the divifor, thus: $\frac{5}{8})\frac{3}{8}(=\frac{3}{5}$; for $\frac{5}{8})\frac{3}{8}\left(\frac{8\times3}{5\times8}=\frac{3}{5}\right.$.

8. If a dividend of two or more denominations be given to be divided by a fraction, reduce the higher part or parts of the dividend to the loweft fpecies, and then divide. Thus, to divide 6 l. $9\frac{3}{4}$ s. by $\frac{2}{3}$, fay, 6 l. $= 6\times20$ s. $=120$; and $120+9\frac{3}{4}=129\frac{3}{4}$ s. $=\frac{519}{4}$; and $\frac{2}{3})\frac{519}{4}(\frac{1557}{8}=194\frac{5}{8}$ s. $=9$ l. 14 s. $7\frac{1}{2}$ d.

Or, Divide the given multiplicand by the numerator of the fraction, and multiply the quot by the denominator.

Examp. Divide L. 276 : 16 : 8 among four men, A, B, C, D, fo that A, B, C, may have equal fhares, and D only two thirds of one of their fhares.

$1+1+1+\frac{2}{3}=\frac{3}{3}+\frac{3}{3}+\frac{3}{3}+\frac{2}{3}=\frac{11}{3}$

	L.	*s.*	*d.*	*L.*	*s.*	*d.*		*L.*	*s.*	*d.*	
11)	276	16	8	(25	3	4	$\times3=$	75	10		A.
							$\times3=$	75	10		B.
							$\times3=$	75	10		C.
							$\times2=$	50	6	8	D.
							Proof	276	16	8	

The reafon of the rule will appear by confidering, that the method here ufed is nothing elfe but the reducing the divifor and dividend to a common denominator, and then dividing the one numerator by the other. Thus, $\frac{3}{4})\frac{2}{3}(\frac{8}{9}$, for reducing the divifor and dividend to a common denominator, we have $\frac{9}{12})\frac{8}{12}(=\frac{8}{9}$.

The truth of the rule may alfo be proved by affuming two fractions equal to two integers, fuch as, $\frac{6}{3}$ and $\frac{16}{4}$, equal to 2 and 4, and the quot of the fractions will be equal to the quot of the integers. Thus, $\frac{6}{3})\frac{16}{4}(\frac{48}{24}=2$, and 2) 4 (2.

The Simple Rule of Three in Vulgar Fractions.

The queftion is ftated as formerly taught in the rule of three. The extremes muft be of one denomination. Reduce mixt numbers and integers to improper fractions, compound fractions to fimple ones, and then work by the following rule, *viz.*

Multiply the fecond and third terms, and divide the product by the firft term; that is, multiply the numerator of the firft term into the denominators of the fecond and third, for the denominator of the anfwer; and multiply the denominator of the firft term into the numerators of the fecond and third, for the numerator of the anfwer.

I. *Direct.*

Quest. If $\frac{3}{4}$ yard coft $\frac{5}{8}$ l. what will $\frac{9}{10}$ yard coft?

Yd. *L.* *Yd.*

If $\frac{3}{4} : \frac{5}{8} :: \frac{9}{10}$.

Anf. $\frac{4\times5\times9}{3\times8\times10}=\frac{5\times9}{3\times2\times10}=\frac{9}{3\times2\times2}=\frac{3}{2\times2}=$ $\frac{3}{4}$ l. $=\frac{3\times20}{4}$ s. $=\frac{60}{4}=15$ s.

II. *Inverfe.*

Quest. If $\frac{3}{4}$ yard of cloth that is 2 yards wide, will make a garment, how much of any other cloth that is $\frac{3}{5}$ yard wide will make the fame garment?

Bread. *len.* *Bread.*

$\frac{3}{5} : \frac{3}{4} :: \frac{2}{1}$.

Anf. $\frac{5\times3\times2}{3\times4\times1}=\frac{5\times2}{4}=\frac{5}{2}=2\frac{1}{2}$ yards.

The

The Compound Rule of Three in Vulgar Fractions.

QUEST. If $\frac{3}{4}$ acre of graſs be cut down by 2 men in $\frac{2}{3}$ day, how many acres ſhall be cut down by 6 men in $3\frac{1}{3}$ days?

$$\begin{array}{lcccc} & \textit{Men.} & \textit{acr.} & & \textit{men.} \\ & \frac{2}{1} & : \frac{3}{4} & :: & \frac{6}{1}. \\ \text{day} & \frac{2}{3} & & & 3\frac{1}{3}=\frac{10}{3} \text{ days.} \\ & \frac{4}{3} & : \frac{3}{4} & :: & \frac{60}{3}. \end{array}$$

Anſ. $\frac{3\times3\times60}{4\times4\times3}=\frac{3\times60}{4\times4}=\frac{3\times15}{4}=\frac{45}{4}=11\frac{1}{4}$ acr.

Or thus:

Anſ. $\frac{3\times1\times3\times6\times10}{2\times2\times4\times1\times3}=\frac{3\times6\times10}{2\times2\times4}=\frac{3\times3\times5}{2\times2}=\frac{45}{4}=$ $11\frac{1}{4}$ acres.

CHAP. X. RULES OF PRACTICE.

WHEN the firſt term of a queſtion in the rule of three happens to be unity, the anſwer may frequently be found more ſpeedily and eaſily than by a formal ſtating or working of the rule of three; and the directions to be obſerved in ſuch operations are called *Rules of Practice.*

The rules of practice naturally follow the doctrine of vulgar fractions, the operation being nothing elſe but a multiplying the number whoſe price is required, by ſuch a fraction of a pound, of a ſhilling, or of a penny, as denotes the rate or price of one.

Thus, if the price of 24 yards, at 6 s. 8 d. *per* yard, be demanded, the anſwer is found by multiplying 24 by $\frac{1}{3}$, the fraction of a pound equivalent to 6 s. 8 d. *viz.* $\frac{24}{1}\times\frac{1}{3}=\frac{24}{3}=8$ l.

Hence, it is obvious, that to multiply a number by a fraction whoſe numerator is unity, is to divide the ſaid number by the denominator of the fraction. But if the numerator of the fraction be not unity, you muſt firſt multiply the given number by the numerator, and then divide the product by the denominator. Thus, if the rate be 13 s. 4 d.$=\frac{2}{3}$ l. the price of 24 yards is found by ſaying, $\frac{24}{1}\times\frac{2}{3}=\frac{48}{3}=16$ l.; or take $\frac{1}{3}$ of the given number twice.

When the fraction denoting the rate happens to be compound, the product or anſwer is found by dividing the given number by one of the denominators of the compound fraction, the quot by another, and the next quot by the third, *&c.* Thus, if the rate be 2 farthings$=\frac{1}{2}$ of $\frac{1}{12}$ of $\frac{1}{20}$ l. the price of 1440 yards is found by ſaying, $\frac{1440}{2}=720$, and $\frac{720}{12}=60$, and $\frac{60}{20}=3$ l.

When the rate is expreſſed by two or more ſimple fractions, connected with the ſign +, the product or anſwer is found by dividing the given number ſucceſſively by the ſeveral denominators, and then adding the quot. Thus, if the rate be 3 s.$=\frac{1}{10}+\frac{1}{20}$ l. the price of 80 yards is found by ſaying, $\frac{80}{10}=8$, and $\frac{80}{20}=4$, and $8+4=12$ l.

The fractions equivalent to any number of farthings under 4, to any number of pence under 12, and to any number of ſhillings under 20, are exhibited in the following tables.

TABLE I.

Farthings.	*of a penny.*	*of a ſhilling.*	*of a pound.*
1	$\frac{1}{4}$	$\frac{1}{4}$ of $\frac{1}{12}$	$\frac{1}{4}$ of $\frac{1}{12}$ of $\frac{1}{20}$
2	$\frac{1}{2}$	$\frac{1}{2}$ of $\frac{1}{12}$	$\frac{1}{2}$ of $\frac{1}{12}$ of $\frac{1}{20}$
3	$\frac{3}{4}$	$\frac{3}{4}$ of $\frac{1}{12}$	$\frac{3}{4}$ of $\frac{1}{12}$ of $\frac{1}{20}$

TABLE II.

Pen.	*of a ſhill.*
1	$\frac{1}{12}$
$1\frac{1}{2}$	$\frac{1}{8}$
2	$\frac{1}{6}$
3	$\frac{1}{4}$
4	$\frac{1}{3}$
5	$\frac{1}{4}+\frac{1}{6}$
6	$\frac{1}{2}$
7	$\frac{1}{3}+\frac{1}{4}$
8	$\frac{1}{3}+\frac{1}{3}$
9	$\frac{1}{2}+\frac{1}{4}$
10	$\frac{1}{2}+\frac{1}{3}$
11	$\frac{1}{3}+\frac{1}{3}+\frac{1}{4}$

TABLE III.

s.	*d.*	*of a pound.*	*s.*	*d.*	*of a pound.*
1		$\frac{1}{20}$	9		$\frac{4}{10}+\frac{1}{20}$
1	8	$\frac{1}{12}$	10		$\frac{5}{10}$, or $\frac{1}{2}$
2		$\frac{1}{10}$	11		$\frac{5}{10}+\frac{1}{20}$
2	6	$\frac{1}{8}$	12		$\frac{6}{10}$, or $\frac{3}{5}$
3		$\frac{1}{10}+\frac{1}{20}$	13		$\frac{6}{10}+\frac{1}{20}$
3	4	$\frac{1}{6}$	13	4	$\frac{2}{3}$
4		$\frac{2}{10}$, or $\frac{1}{5}$	14		$\frac{7}{10}$
5		$\frac{2}{10}+\frac{1}{20}$, or $\frac{1}{4}$	15		$\frac{7}{10}+\frac{1}{20}$, or $\frac{3}{4}$
6		$\frac{3}{10}$	16		$\frac{8}{10}$, or $\frac{4}{5}$
6	8	$\frac{1}{3}$	17		$\frac{8}{10}+\frac{1}{20}$
7		$\frac{3}{10}+\frac{1}{20}$	18		$\frac{9}{10}$
8		$\frac{4}{10}$, or $\frac{2}{5}$	19		$\frac{9}{10}+\frac{1}{20}$

The fractions in Table II. become compound fractions of a pound, by annexing (of $\frac{1}{20}$) to each of them. Thus, 1 d. is $\frac{1}{12}$ of $\frac{1}{20}$ l.; and 5 d. is $\frac{1}{4}$ of $\frac{1}{20}+\frac{1}{6}$ of $\frac{1}{20}$ l. *&c.*

The variety that occurs in the rules of practice ariſes chiefly from the different rates, or prices, of one thing, as a yard, a pound, an ounce, *&c.* and may be reduced to the eight caſes following, *viz.*

The rate may be, 1. Farthings under four. 2. Pence under twelve. 3. Pence and farthings. 4. Shillings under twenty. 5. Shillings, pence, and farthings. 6. Pounds. 7 Pounds, ſhillings, pence, and farthings. 8. The given number may conſiſt of integers and parts.

CASE I. When the rate is farthings, under four.

RULE. Divide the given number by the denominator of the fraction denoting the rate, as contained in Tab. I. *viz.* if the rate be 1 or 2 farthings, divide by 4 or 2, the quot will be pence; and the remainder, in dividing by 4, will be farthings, and in dividing by 2, it will be 1 halfpenny: then divide the pence by 12, the quot will be ſhillings, and the remainder pence. laſtly, divide the ſhillings by 20, the quot will be pounds, and the remainder ſhillings. But if the rate is 3 farthings, firſt multiply the given number by the numerator 3, and then divide as above directed.

Ex. 1.

$\frac{1}{4}$	4859, at 1 f.
$\frac{1}{12}$	1214—3 f.
$\frac{1}{20}$	10|1—2 d.
	L.5 1 $2\frac{3}{4}$

Ex. 2.

$\frac{1}{2}$	8347, at 2 f.
$\frac{1}{12}$	4173—$\frac{1}{2}$ d.
$\frac{1}{20}$	3|7—9 d.
	L.17 7 $9\frac{1}{2}$

CASE II. When the rate is pence, under twelve.

RULE. Divide the given number by the denominator of the fraction denoting the rate, as contained in Table II. and you have the anſwer in ſhillings; which reduce into pounds, by dividing by 20.

	Ex. 1.		*Ex.* 2.
$\frac{1}{12}$	818, at 1 d.	$\frac{1}{6}$	5316, at 2 d.
$\frac{1}{20}$	6|8—2 d.	$\frac{1}{20}$	88|6
	L. 3 8 2		L. 44 6

Note, The remainders at the first division in the above examples are the same with the rate. Thus, in Ex. 1. every remainder is 1 d.

Case III. When the rate is pence and farthings.

Rule. The pence must be some aliquot part of a shilling; and, at the same time, the farthings some aliquot part of the pence; and if they be not so given, divide the pence into two or more such parts, so as the farthings may be some aliquot part of the lowest division of the pence. Then, beginning with the highest division of the pence, divide by the denominators of the fractions denoting the aliquot parts.

		Ex. 1.			*Ex.* 2.
1 d.	$\frac{1}{12}$	532, at $1\frac{1}{4}$ d.	1 d.	$\frac{1}{12}$	1753, at $1\frac{1}{2}$ d.
$\frac{1}{4}$ d.	$\frac{1}{4}$	44—4	$\frac{1}{2}$ d.	$\frac{1}{2}$	146—1
		11—1			73—$0\frac{1}{2}$
	$\frac{1}{20}$	5|5—5		$\frac{1}{20}$	21|9—$1\frac{1}{2}$
		L. 2 15 5			L. 10 19 $1\frac{1}{2}$

Explication.

In Ex. 1. work first for 1 d.; which being $\frac{1}{12}$ s. divide the given number by the denominator 12, and the quot is shillings, and the remainder pence; then, because 1 farthing is $\frac{1}{4}$ d. divide the former quot by 4, and the sum of the quots is the price in shillings; which divide by 20.

In Ex. 2. the rate $1\frac{1}{2}$ d. being an aliquot part of a shilling, the second method is shorter and better than the first.

Case IV. When the rate is shillings under twenty.

Rule. Multiply the given number by the numerator of the fractions contained in Tab. III. and divide the product by the denominators. Or, instead of this general rule, take the two particular ones following.

1. If the rate be an even number of shillings, multiply the given number by half the number of shillings in the rate, always doubling the right-hand figure of the product for shillings, and the rest are pounds.

2. If the rate be an odd number of shillings, work for the next lesser even number of shillings, as above; and for the odd shilling take $\frac{1}{20}$ of the given number.

Examp. 1. When the rate is an even number of shillings.

Ex. 1.	*Ex.* 2.
436, at 2 s.	127, at 4 s.
1	2
L. 43, 12 s.	L. 25, 8 s.

2. When the rate is an odd number of shillings.

Ex. 1.	*Ex.* 2.
635, at 1 s.	422, at 3 s.
L. 31, 15 s.	42 4
	21 2
	L. 63, 6 s.

Note 1. The reason of multiplying by half the number of shillings in the rate will appear by considering, that these are the numerators of the fractions denoting the rate. Thus, 2 s. is $\frac{1}{10}$ l. and 4 s. is $\frac{2}{10}$ l. and 6 s. is $\frac{3}{10}$ l. and each unit in the product is two shillings. The division by the denominator 10 is performed by cutting off the right-hand figure of the product, and the figure so cut off is the remainder; and as each unit in the remainder is two shillings, the double of them is the remainder in shillings.

Note 2. From Ex. 1. we may learn, that when the rate is 2 s. the price is found by doubling the right-hand figure of the given number for shillings, and the other figure or figures are pounds.

Note 3. In Ex. 2. the price may also be had by taking $\frac{1}{5}$ of the given number; and in this way every remainder will be 4 s.

Note 4. By reversing the operation, from the price and any even rate given, we may readily find the quantity of goods, *viz.* Multiply the price by 10, that is, to the price annex a cipher, and divide the product by half the rate.

Ex. 1. How many yards, at 14 s. may be bought for 49 l. 7)490(70 yards. *Ans.*

Ex. 2. How many gallons, at 8 s. may be bought for 500 l.? 4)5000(1250 gallons. *Ans.*

Case V. When the rate is shillings and pence, or shillings, pence, and farthings.

Rule I. If the rate be shillings and pence which make an aliquot part of a pound, divide the given number by the denominator of the fraction denoting the rate; the quot is pounds, and each unit of the remainder is equal to the rate.

	Ex. 1.
$\frac{1}{12}$	354, at 1 s. 8 d.
	L. 29, 10.
	Ex. 2.
$\frac{1}{8}$	443, at 2 s. 6 d.
	L. 55 7 6

Rule II. If the rate be no aliquot part of a pound, but may be divided into such parts, divide it accordingly, work for the parts separately, and then add.

		Ex. 1.			*Ex.* 2.
		427, at 8 s. 6 d.			540, at 5 s. 4 d.
6 s.	$\frac{3}{10}$	128 2	3 s. 4 d.	$\frac{1}{6}$	90
2 s. 6 d.	$\frac{1}{8}$	53 7 6	2 s.	$\frac{1}{10}$	54
		L. 181 9 6			L. 144

Rule III.

Rule III. If the rate be no aliquot part of a pound, and cannot readily be divided into ſuch parts, divide it into parts whereof one at leaſt may be an aliquot part of a pound, and the ſubſequent part, or parts, each an aliquot part of ſome prior part.

Ex. 1. 350|6, at 1 s. 3d.

1 s.	$\frac{1}{20}$	175	6	
3 d.	$\frac{1}{4}$	43	16	6
		L. 219	2	6

Ex. 2. 9|5, at 1 s. $10\frac{1}{2}$ d.

1 s.	$\frac{1}{20}$	4	15	
6 d.	$\frac{1}{2}$	2	7	6
3 d.	$\frac{1}{2}$	1	3	9
$1\frac{1}{2}$ d.	$\frac{1}{2}$		11	$10\frac{1}{2}$
		L. 8	18	$1\frac{1}{2}$

Case VI. When the rate is pounds.

Rule. Multiply the given number by the rate, and the product is the price in pounds.

Ex. 1. 42, at 2 l.
L. 84

Ex. 2. 13, at 8 l.
L. 104

Case VII. When the rate is pounds and ſhillings, or pounds, ſhillings, pence, and farthings.

Rule I. If the rate be pounds and ſhillings, multiply the given number by the pounds, and work for the ſhillings as in Caſe IV.

Ex. 1. 46, at 1 l. 4 s.

1 l.	46	
4 s.	9	4
	L. 55	4

Ex. 2. 82, at 4 l. 10 s.

4 l.	328	
10 s	41	
	L 369	

Note. When the rate is more than 1 l. and leſs than 2 l. as in Ex. 1. we have no occaſion to draw a line under the given number, it being eſteemed ſo many pounds, and the parts for the ſhillings or pence are added up with it.

Rule II. If the rate be pounds, with ſhillings and pence that make ſome aliquot part of a pound, or are diviſible into aliquot parts, or into ſhillings and ſome aliquot part or parts; then multiply the given number by the pounds, and work for the ſhillings and pence as in Caſe V. Rule I. or II.

Ex. 1. 54, at L. 3:2:6.

3 l.	162		
2s. 6d.	6	15	
	L. 168	15	

Ex. 2. 43, at L. 5:3:4.

5 l.	215		
3s. 4d.	7	3	4
	L. 222	3	4

Rule III. If the rate be pounds, with ſhillings, pence, and farthings, that cannot readily be reſolved into aliquot parts of a pound; multiply the given number by the pounds; and then work for the ſhillings, pence, and farthings, as in Caſe V. Rule III.

Ex. 1. 213, at 1 l. 13 s. $4\frac{1}{2}$ d.

1 l.	213		
10 s.	106	10	
2 s.	21	6	
1 s.	10	13	
3 d.	2	13	3
$1\frac{1}{2}$ d.	1	6	$7\frac{1}{2}$
	L. 355	8	$10\frac{1}{2}$

Ex. 2. 37, at 3 l. 8 s. $10\frac{1}{4}$ d.

3 l.	111		
6 s.	11	2	
2s. 6d.	4	12	6
3 d.		9	3
1 d.		3	1
$\frac{1}{4}$ d.			$9\frac{1}{4}$
	L. 127	7	$7\frac{1}{4}$

Case VIII. When the given number conſiſts of integers and parts.

Rule. Work for the price of the integers as already taught; and for the part or parts, take a proportional part or parts of the rate.

Ex. 1. *Yards.* $720\frac{1}{4}$, at 6s. 8d. *per* yd.

6s. 8d.	240		
$\frac{1}{4}$ yd.	0	1	8
	L. 240	1	8

Ex. 2. *Yards.* $116\frac{1}{2}$, at 4s. 6d. *per* yd.

2s. 6d.	14	10	
2 s.	11	12	
$\frac{1}{2}$ yd.		2	3
	L. 26	4	3

An operation in the rules of practice may be proved by running over the ſeveral ſteps a ſecond time, by working the ſame queſtion a different way, or by the rule of three.

Chap. XI. *Of* Decimals.

I. *Notation.*

A Fraction having 10, 100, 1000, or unity with any number of ciphers annexed to it, for a denominator, is called a *decimal fraction;* ſuch as, $\frac{7}{10}$, $\frac{25}{100}$, $\frac{34}{1000}$, $\frac{85}{10000}$.

In decimal fractions, as in vulgar, the denominator ſhews into how many parts the unit or integer is divided, and the nnmerator ſhews how many of theſe parts the fraction contains. Thus, if the fraction be $\frac{9}{10}$, the unit is divided into ten equal parts, and the fraction contains nine of theſe parts; and conſequently, if the unit or integer be a pound Sterling, the value of ſuch a fraction is eighteen ſhillings.

We may conceive the denominator of a decimal fraction to be formed by dividing the unit into 10 equal parts, and each of theſe parts into 10 other equal parts, each of theſe again into 10 other equal parts, and ſo on, as far as neceſſary; and hence a decimal fraction will always be ſo many tenths, or ſo many tenths of $\frac{1}{10}$, or ſo many tenths of $\frac{1}{10}$ of $\frac{1}{10}$, *&c.*; and by reducing the compound fraction to a ſimple one, we have the decimal. Thus, $\frac{8}{10}$ of $\frac{1}{10}$ of $\frac{1}{10} = \frac{8}{1000}$.

Or

Or we may conceive the denominator of a decimal to be formed by the continual multiplication of unity into 10, as often as there are ciphers in it. Thus, $1 \times 10 = 10$, and $1 \times 10 \times 10 = 100$, and $1 \times 10 \times 10 \times 10 = 1000$, &c. And because the fractions $\frac{9}{10}$, $\frac{99}{100}$, $\frac{999}{1000}$, &c. have the highest numerators possible, it is plain, that the number of figures or places in the numerator of a decimal can never exceed the number of ciphers in the denominator.

It is usual to write down only the numerator of a decimal fraction, omitting the denominator; and when the numerator has the same number of figures or places as the denominator has ciphers, it is done by writing down the figures of the numerator, and prefixing a point, to distinguish them from a whole number. So $\frac{7}{10}$ is written thus, .7; and $\frac{25}{100}$ is written thus, .25. The point thus prefixed is called the *decimal point*.

But when the numerator has not so many figures or places as there are ciphers in the denominator, the defect is supplied by prefixing a cipher for every figure wanting, and then placing the decimal point on the left. So $\frac{3}{100}$ is written thus, .03; and $\frac{75}{10000}$ thus, .0075; and $\frac{5}{10000}$ thus, .0005.

From this manner of notation, it is easy to read a decimal, or to know its denominator, *viz.* imagine 1 to stand under the decimal point, and a cipher under every decimal place. Thus, .9 is $\frac{9}{10}$, and .48 is $\frac{48}{100}$, and .05 is $\frac{5}{100}$, and .007 is $\frac{7}{1000}$, and .00036 is $\frac{36}{100000}$.

Hence it is plain, that decimals, like integers, decrease from the left to the right, and increase from the right to the left, in a decuple proportion. On the contrary, any decimal figure, by being removed one place toward the left, becomes ten times greater.

An integer, by annexing ciphers, is raised to higher places on the left, and may by this means have its value increased to infinity. On the other hand, a decimal, by prefixing ciphers, is depressed to lower places on the right, and may by this means have its value diminished to infinity.

Ciphers annexed to decimals do not change the value of the decimals. Thus, $.50 = 5$, and $.500 = 5$, for $.50 = \frac{5|0}{10|0} = \frac{5}{10} = .5$; and $\frac{5|00}{10|00} = \frac{5}{10} = .5$.

Decimals may be resolved into constituent parts, and the parts may be read, separately, thus, $.847 = .8 + .04 + .007 = \frac{8}{10} + \frac{4}{100} + \frac{7}{1000}$.

In decimals the figure next the point, being the first decimal place, is sometimes called *primes*, and the second figure from the point is called *seconds*, the next *thirds*, &c. Thus, in .875 the figure 8 is primes, 7 is seconds, and 5 is thirds.

From this brief account of the nature of decimals, it follows, that the manner of operation in decimals will be the same as in whole numbers; and also, that the same number may be differently expressed, according as the integer is chosen. Thus, the time since our Saviour's birth may be written thus, 1769; or thus, 176.9; or thus, 17.69; or thus, 1.769; or thus, .1769, according as one year, a decad, a century, a chiliad, or myriad, is used as the integer. Hence arises the superior excellency of decimal arithmetic, above every other sort of numerical computation; as will appear in the sequel.

II. *Reduction of Decimals.*

PROB. I. To reduce a vulgar fraction to a decimal.

RULE. To the numerator of the vulgar fraction affix a point or comma, then annex a competent number of ciphers, and divide by the denominator; the quot is the numerator of the decimal, and the cyphers annexed show the number of decimal places.

EXAMP. I. Reduce $\frac{1}{2}$ to a decimal?

Here to the numerator 1 annex one cipher, and dividing by the denominator 2, the quot is 5, and 0 remains; and because a single cipher only was annexed to the numerator, the decimal numerator will consist but of one figure, namely 5; to which, therefore, prefix the decimal point. So $\frac{1}{2} = .5$.

```
2)1.0(.5
  10
  --
  (0)
```

Hence appears the reason of the rule; namely, 2 : 1 :: 10 : 5; that is, as the vulgar denominator to the vulgar numerator, so is the decimal denominator to the decimal numerator.

EXAMP. II. Reduce $\frac{3}{4}$ to a decimal.

To the numerator 3, annex two ciphers; and, dividing by the denominator, the quot gives 75 for the numerator of the decimal, two ciphers having been annexed. So $\frac{3}{4} = .75$.

```
4)3.00(.75
  28
  --
   20
   20
   --
   (0)
```

Though ciphers may be annexed at pleasure, yet it is the ciphers used that determine the number of decimal places in the quot; and at first it is sufficient to annex so many as serve to complete the first dividual, leaving room to annex more as you proceed in the operation; or rather annex the other ciphers to the remainders, without giving them a place in the dividend.

The first dividual also shows whether ciphers ought to be prefixed to the quot, and how many. Thus, if the first dividual take in only one of the annexed ciphers, the figure put in the quot is primes, and no cipher to be prefixed. If the first dividual comprehend two of the annexed ciphers, the figure put in the quot is seconds, and one cipher must be prefixed. If the first dividual comprehend three of the annexed ciphers, the figure put in the quot is thirds, and two ciphers must be prefixed, &c. Hence, in reducing a vulgar fraction to a decimal, the natural and easy way is, to place first the decimal point in the quot, and after it a cipher or ciphers, or the quotient-figure, as the first dividual directs.

In reducing a vulgar fraction to a decimal, if 0 at last remains, as in all the above examples, the decimal is precisely equal to the vulgar fraction, and is called a *finite* or *terminate decimal*.

In finite decimals, the denominator is always some aliquot part of the numerator increased by annexing ciphers; and such decimals take their rise from vulgar fractions whose denominator is 2 or 5, or some power of

2 or

2 or 5, or the product of ſome of their powers. See Chap. XII. and ALGEBRA, Chap. III.

The powers of numbers are ſometimes expreſſed by indices or exponents placed at the corners of the numbers. Thus, 2^2 ſignifies the ſecond power of 2, and 5^3 ſignifies the third power of 5; and 10^4 ſignifies the fourth power of 10, &c. The index of the root or firſt power is ſeldom expreſſed.

Any power of 2 multiplied into the like power of 5 gives a product equal to the ſame power of 10; as appears from the following ſpecimen of the powers of 2, 5, and 10.

$2^1 = 2$	$5^1 = 5$	$2 \times 5 = 10^1 = 10$
$2^2 = 4$	$5^2 = 25$	$4 \times 25 = 10^2 = 100$
$2^3 = 8$	$5^3 = 125$	$8 \times 125 = 10^3 = 1000$
$2^4 = 16$	$5^4 = 625$	$16 \times 625 = 10^4 = 10000$
$2^5 = 32$	$5^5 = 3125$	$32 \times 3125 = 10^5 = 100000$
$2^6 = 64$	$5^6 = 15625$	$64 \times 15625 = 10^6 = 1000000$
$2^7 = 128$	$5^7 = 78125$	$128 \times 78125 = 10^7 = 10000000$
&c.	&c.	&c.

The product of two different powers of 2 and 5, is equal to the product that will ariſe by raiſing 10 to the power denoted by the leſſer given index, and then multiplying this power of 10 into that power of the other number which is denoted by the difference of the two given exponents. Thus,

$$2^6 \times 5^2 = 64 \times 25 = 10^2 \times 2^4 = 100 \times 16 = 1600$$
$$2^2 \times 5^6 = 4 \times 15625 = 10^2 \times 5^4 = 100 \times 625 = 62500$$

From theſe remarks it is eaſy to perceive, that 2 or 5, or any of their powers, or product of their powers, will meaſure 10 or its powers, *viz.* 100, 1000, &c. or their multiples, ſuch as, 20, 200, 2000, &c. 30, 300, 3000, &c.; and ſuch every numerator becomes by having ciphers annexed; and therefore 2 or 5, or their powers, or product of their powers, uſed as a denominator, will divide any numerator with a competent number of ciphers annexed, and leave no remainder; and conſequently the decimal thence reſulting will be finite.

If the numerator of the vulgar fraction be unity, and the denominator any ſingle power of 2 or 5, there will be as many decimal places in the quot as there are units in the index of the given power. Thus, $16 = 2^4$ gives a decimal of four places, *viz.* $\frac{1}{16} = .0625$; and, $125 = 5^3$ gives a decimal of three places, *viz.* $\frac{1}{125} = .008$.

When the denominator is the product of like powers of 2 and 5; in this caſe, ſuch a product being equal to the like power of 10, and any power of 10 being equal to 1, with as many ciphers annexed as there are units in the index, it follows, that there will ſtill be as many decimal places in the quot as there are units in the index, either of 2, of 5, or 10. Thus, $8 \times 125 = 2^3 \times 5^3 = 10^3 = 1000$, gives a decimal of three places, *viz.* $\frac{1}{1000} = .001$.

When the denominator is the product of different powers of 2 or 5, find what power of 10, and what power of 2 or 5, upon being multiplied, will give the ſame product, as is taught above; and the ſum of the indices ſhews the number of decimal places; thus, $2^6 \times 5^2 = 10^2 \times 2^4$; and the ſum of the indices, $2 + 4 = 6$, gives the number of decimal places, *viz.* $\frac{1}{1600} = .000625$.

And, in general, to find what number of decimal places any ſuch vulgar fraction will give, divide the denominator by 2, 5, or 10, till the laſt quotient be 1, and the remainder 0; and the number of diviſors ſhews the number of decimal places. Thus, $\frac{1}{16}$ gives a deci-
2)2)2)
mal of four places; for 2)16(8(4(2(1. And $\frac{1}{125}$ gives
5)5)
a decimal of three places; for 5)125(25(5(1. And $\frac{1}{1000}$ gives a decimal of three places; for 10)1000
10)10)
(100(10(1. And $\frac{1}{1600}$ gives a decimal of ſix places;
10) 2) 2)2)2)
for 10)1600(160(16(8(4(2(1.

If the denominator of a vulgar fraction be neither 2 nor 5, nor any of their powers, nor product of their powers, ſuch a denominator will not divide the numerator with annexed ciphers without a remainder; and the decimal thence reſulting is called *infinite*, or *interminate*.

Of infinite or interminate decimals, there are two ſorts. For ſome conſtantly repeat the ſame figure; and are called *repeating decimals*, *repeaters*, or *ſingle repetends*. Others repeat a circle of figures; and on that account are called *circulating decimals*, *circulates*, or *compound repetends*.

EXAMP. III. Reduce $\frac{1}{3}$ to a decimal.

Here the remainder being ſtill the ſame, *viz.* 1, the ſame figure will conſtantly be repeated in the quot.

```
3)1.0(.3
   9
  ---
  (1)
```

Repeating decimals are of two kinds: *viz.* ſome conſiſt only of the repeating figures, ſuch as the examples above; and theſe are called *pure repeaters*; others have one or more digits or ciphers betwixt the decimal point and the repeating figure; and theſe are called *mixt repeaters*; and the digits or ciphers on the left of the repeating figures are called the *finite part* of ſuch decimals.

Pure repeaters take their riſe from vulgar fractions whoſe denominator is 3, or its multiple 9; and are but few in number.

Mixt repeaters derive their origin from vulgar fractions whoſe denominator is the product of 3 into 2 or 5, or into ſome of their powers, or product of their powers; and ſuch denominators may be conſidered as the product of two component parts, whereof one is 2 or 5, or ſome of their powers, or product of their powers; and hence the finite part. The other component part is 3; and hence the repeating figure.

EXAMP. IV. Reduce $\frac{4}{15}$ to a decimal.

Here the repeater is mixt, the finite part being 2, and the repeating figure 6.

```
15)4.0(.26
    30
   ----
   *100
     90
   ----
    (10)
```


We

We now resolve such denominators into their component parts, and divide the numerator by one of these parts, and then divide the quot by the other. Thus, $15=5\times3$.

```
5)4.0(.8          and 3).8(.2̸6
  40                   6
  ——                   ——
  (0)                * 20
                       18
                       ——
                       (2)
```

The number of places in the finite part of a mixt repeater may be ascertained from the number of units in the index of the powers of 2 or 5.

And, universally, to find the number of places in the finite part of such fractions, divide the denominator first by 3, and then divide the quot by 2, 5, or 10, till the last quot be 1, and 0 remain; and the number of divisors, excluding 3, shows the number of places in the finite part.

Repeating decimals are usually marked by a dash through the right-hand figure, as in the examples above: But some chuse to mark them by a point set over the repeating figure, thus, $.\dot{3}$, $.2\dot{6}$. The remainder where the repetition begins is commonly marked with an asterisk.

Because any quotient multiplied by the divisor reproduces the dividend, it follows, that any decimal multiplied by the denominator of the vulgar fraction from which it resulted, will reproduce the numerator with the annexed ciphers. Thus, if .75, the decimal of $\frac{3}{4}$, be multiplied by 4, it will reproduce the numerator 3 and the two annexed ciphers.

Now, suppose the given decimal to be a repeater; such as $.\not{3}$, resulting from the vulgar fraction $\frac{1}{3}$, if the repeating decimal be multiplied by the denominator 3, it will, by carrying at 9 on the right hand, reproduce the numerator 1 with the annexed cipher. In like manner, if the repeater $.\not{6}=\frac{2}{3}$, be multiplied by 3, it will, by carrying at 9 on the right hand, reproduce the numerator 2 with the annexed cipher. Again, if the repeater $.\not{1}=\frac{1}{9}$, be multiplied by the denominator 9, it will, by carrying at 9 on the right hand, reproduce the numerator 1 with the annexed cipher. And, if the mixt repeater $.2\not{6}=\frac{4}{15}$, be multiplied by the denominator 15, it will, by carrying at 9 on the right hand, reproduce the numerator 4 with the two annexed ciphers.

From these remarks we may conclude, that the right-hand figure of every repeating decimal is ninth-parts: and the same truth may be evinced by resolving the decimal into its constituent parts, in the following manner.

The vulgar fraction $\frac{7}{9}$ reduced to a decimal gives $.\not{7}7$, &c.; and this repeater resolved into decimal constituent parts, becomes $\frac{7}{10}+\frac{7}{100}+\frac{7}{1000}$, &c. to infinity. But if we esteem the right-hand figure to be ninth-parts, we have $\frac{7}{10}+\frac{7}{9}$ of $\frac{1}{10}=\frac{7}{10}+\frac{7}{90}=\frac{630}{900}+\frac{70}{900}=\frac{700}{900}=\frac{7}{9}$, the given vulgar fraction. And as the vulgar fraction $\frac{7}{9}$ gives $.\not{7}7$, so $\frac{9}{9}$ gives $.\not{9}9$; that is, $.\not{9}9=\frac{9}{9}=1$. And, universally, a series of nines infinitely continued is equal to unity in the place on the left hand; thus, $.\not{9}99=1$; and $.0\not{9}99=.1$; and $.00\not{9}9=.01$. and $45.\not{9}9=45$.

Hence may be ascertained the value of an infinite series decreasing in a decuple proportion. Thus, $\frac{1}{10}+\frac{1}{100}+\frac{1}{1000}$, &c. $=\frac{1}{9}$. And $\frac{2}{10}+\frac{2}{100}+\frac{2}{1000}$, &c. $=\frac{2}{9}$.

If the denominator of a vulgar fraction be neither 2 nor 5, nor any power of 2 or 5, nor any product of their powers; nor 3, nor 9, nor any product of 3 into 2 or 5, or into some of their powers, or product of their powers, the decimal resulting from such a vulgar fraction will circulate.

Circulates, like repeaters, are of two sorts, *viz.* pure and mixt. A pure circulate consists of the figures of the circle only; as .09, 09, &c. or 18, 18, &c. A mixt circulate has a finite part betwixt the decimal point and the figure that begins the circle; as .0, 45, 45, &c.; or .32, 142857, 142857, &c. Some chuse to distinguish the finite part from the circle, and one circle from another, by a comma, as above. Others dash the first and last figure of the circle. It is likewise usual to mark the remainder where the new circle begins, by affixing an asterisk.

EXAMP. V. Reduce $\frac{1}{11}$ to a decimal.

The denominator 11 gives a pure circle of two figures.

```
11)1.00(.09.09,
      99
      ——
    * 100
      99
      ——
    * 1
```

$\frac{2}{11}=.18, 18,$	$\frac{7}{11}=.63, 63,$
$\frac{3}{11}=.27, 27,$	$\frac{8}{11}=.72, 72,$
$\frac{4}{11}=.36, 36,$	$\frac{9}{11}=.81, 81,$
$\frac{5}{11}=.45, 45,$	$\frac{10}{11}=.90, 90,$
$\frac{6}{11}=.54, 54,$	

It is easy to perceive, that if any of the vulgar fractions in the above specimen have both its numerator and denominator multiplied by 9, there will arise a new vulgar fraction of the same value, whose numerator will be the figures of the circle, and its denominator the like number of 9's. Thus,

$$\frac{3\times9}{11\times9}=\frac{27}{99}, \text{ and } \frac{7\times9}{11\times9}=\frac{63}{99}.$$

As the denominator 11, whereof 99 is a multiple, gives a pure circulate of two places, so any denominator, whereof 999, or 9999, or 99999, &c. are multiples, will give a pure circulate of three, four, five, &c. places; that is, of as many places as there are 9's in the multiple. And such denominators are all the prime numbers, except 2, 3, and 5, *viz.* 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, &c.; also their products into 3, *viz.* 21, 33, 39, 51, 57, 69, &c. Such too are all the powers of 3, except 3 and 9, *viz.* 27, 81, 243, 729, 2187, &c.

The reason is plain: for if any divisor, as 37, divide 999, without a remainder, it will also divide 1000, and leave a remainder of 1, to begin a new circle.

To find how many places the circle will consist of, divide a competent number of 9's by any of the above denominators, continuing the operation till 0 remain; and the number of 9's used will show the number of places.

Thus,

Thus, 7)999999 six places. Thus, 27)999 three places.
142857 37

The number of figures in a circle, when some power of 3 is the denominator, may also be found thus: Divide the given denominator by 9, and the number of units in the quot will be equal to the number of figures in the circle. Thus, 9)27(3 places. Thus, 9)81(9 places, &c.

If 3 divide a repeater whose repeating figure is not a multiple of 3, the quot will be a pure circulate of three places. Thus, 3).111(.037, and 3).555(.185, and 3).777(.259.

If 3 divide a pure circulate, the circle not being a multiple of 3, the quot will be a pure circulate of thrice as many places as the circle of the dividend. Thus, 3).037,037,037(.012345679.

Mixt circulates take their rise from fractions whose denominators are the prime numbers 7, 11, 13, 17, 19, 23, 29, &c. multiplied into 2, 5, or 10, or into some of their powers, or product of their powers.

EXAMP. VI. Reduce $\frac{9}{28}$ to a decimal.

28)9.0(.32,142857,14
84
60
56
*40
28
120
112
80
56
240
224
160
140
200
196
*40
28
120
112
8

The denominator $28 = 7 \times 2 \times 2$, gives a mixt circulate, consisting of the finite part 32, and a circle of six figures or places, whose sum is equal to the product of 9 into half the number of figures; that is, $9 \times 3 = 27$.

The number of places, both in the finite part and in the circle, may be ascertained thus: Divide the denominator of the vulgar fraction by 10, 5, or 2, as often as possible, and the number of divisors will show the number of places in the finite part; make the last quot a divisor, and the dividend any competent number of 9's; continue the operation till 0 remain, and the number of 9's used will be equal to the number of places in the circle. Thus, 10) 5)
10).0500(2050,205,41; and 41)99999(2439, and 0 remains. So you may conclude, that the finite part will consist of three places, and the circle of five.

Universally, any vulgar fraction being given, we may determine whether the decimal thence resulting will be finite or infinite; and if infinite, whether pure or mixt; with the number of places, &c. in the following manner.

Reduce the given vulgar fraction to its lowest terms, then divide the denominator by 10, 5, or 2, as often as possible; and if the last quot be unity, without any remainder, the decimal is finite, amd the number of divisors shews the number of decimal places.

If the last quot be 3, or any power of 3, the resulting decimal will be a mixt repeater, the number of whose finite places will be equal to the number of divisors.

If the last quot cannot be divided by 2, 5, 10, or 3, the resulting decimal will be a mixt circulate; and the way of finding the number of places, both in the finite part and circle, is taught above.

If the denominator of the given vulgar fraction can be divided, neither by 2, 5, nor 10, the resulting decimal will be a pure repeater, or a pure circulate, according as the denominator is 3 or 9, or some of the prime numbers, 7, 11, 13, &c.; as has been already explained.

Every vulgar fraction may be reduced to a decimal, finite or infinite; that is, to a finite decimal, to a repeater, or a circulate. For if the denominator divide the numerator with ciphers annexed, so as to leave no remainder, the resulting decimal is finite. If the remaining figure be always the same, the resulting decimal will be a repeater. If neither of these be the case, yet, because the divisor is a finite number, the remainder at last must either be the same with the numerator of the vulgar fraction, or the same with some preceding remainder, and then a new circle begins; and consequently the resulting decimal will be a circulate.

Because in circulates the circle runs on sometimes to 16, 18, 22, 28, 81, 243, &c. places, and because, in decimals of every sort, the finite part runs sometimes on to many places, such circulates, or finite parts, may, without any sensible error, be limited at five or six places, and used as finites: for five decimal places, divide the integer into 100,000 equal parts, and all the loss that can be occasioned by such limitation, is less than one hundred thousandth part of the integer. And in most cases, the decimal may be limited at three places, which divide the integer into 1000 equal parts.

Circulates, or finite parts, thus limited, are called *approximate decimals*; and are sometimes marked with + or — annexed, according as the right-hand figure is taken less or greater than just: for in limiting the decimal, if you foresee that the succeeding figure of the quot would be 6 or 7, or any figure above 5, you lessen the error by increasing the right-hand figure of the approximate by unity.

PROB. II. To reduce the parts of coin, &c. to decimals.

RULE. Convert the given part or parts to a vulgar fraction

fraction of the integer, and then reduce the vulgar fraction to a decimal.

Ex. 1. Reduce 9 pence to the decimal of a shilling.

d. s.
$9 = \frac{9}{12}$ and 12)9.0(.75 of a shilling.

```
12)9.0(.75
   8 4
   ---
    60
    60
    --
   (0)
```

Here the fraction $\frac{9}{12} = \frac{3}{4}$; and the denominator $4 = 2 \times 2$ gives a finite decimal of two places.

Ex. 2. Reduce 9 pence to the decimal of a pound.

d. L.
$9 = \frac{9}{240}$ 240)9.00(.0375 of a pound.

```
240)9.00(.0375
    7 20
    ----
    1 800
    1 680
    -----
     1200
     1200
     ----
     (0)
```

The fraction $\frac{9}{240} = \frac{3}{80}$; and the denominator $80 = 10 \times 2 \times 2 \times 2$ gives a finite decimal of four places.

Ex 3. Reduce 16 s. 6 d. to the decimal of a pound.

s. d. L.
16 6 $= \frac{198}{240}$ 240)198.0(.825 L.

```
16
12
--
198

240)198.0(.825 L.
    1920
    ----
     6 00
     4 80
     ----
     1 200
     1 200
     -----
      (0)
```

The fraction $\frac{198}{240} = \frac{66}{80} = \frac{33}{40}$; and the denominator $40 = 10 \times 2 \times 2$ gives a finite decimal of three places.

Prob. III. To reduce the remainder of a division to a decimal.

Rule. The remainder being the numerator, and the divisor the denominator of a vulgar fraction, after placing the decimal point on the right of the integral part of the quot, annex ciphers to the remainder; then continue the division till 0 remain, or till the quot repeat or circulate, or till you think proper to limit the decimal; and the number on the right of the point is a decimal of the integer expressed in the quot.

Example 1.
Divide 513l. among 36 men.

```
     L.
36)513(14.25
   36
   ---
   153
   144
   ---
Rem. 90
     72
     ---
     180
     180
     ---
     (0)
```

Example 2.
Divide 176 s. among 24 boys.

```
      s.
24)176(7.3̇
   168
   ---
Rem. 80
     72
     --
     (8)
```

Prob. IV. To reduce a decimal to value.

Rule. Multiply the given decimal by the number of parts of the next inferior denomination contained in an unit of the integer; and from the product point off so many figures to the right hand as there are places in the given decimal. On the left hand of the point are parts, and on the right a decimal of one of these parts; which decimal must be reduced in the same manner to the next inferior denomination, and from that to the next, and so on to the lowest; the several figures on the left of the points are parts; and if there be still some figure or figures on the right, they are a decimal of the lowest of the parts.

Example 1.
Reduce .875 l. to value.

```
L.     s.  d.
.875 = 17  6
 20
-------
s. 17.500
   12
-------
d. 6.0
```

Example 2.
Reduce .7691 l. to value.

```
L.      s.  d. f.
.7691 = 15  4  2
  20
--------
s. 15.3820
   12
--------
d. 4.584
   4
--------
f. 2.336
```

The reason of pointing the product, as the rule directs, is plain. For, in Ex. 1. as 1000 : 875 :: 20 : 17; that is, as the decimal denominator to the decimal numerator, so the vulgar denominator to the vulgar numerator.

In Ex. 1. the full value of the decimal comes out in parts, the decimal being quite exhausted; but in Ex. 2. besides the parts, there is a decimal of a farthing, *viz.* .336 f.

The decimal of a pound Sterling may be reduced to value by inspection, in the following manner.

Double the figure in the place of primes for shillings; and if the figure in the place of seconds be 5, or exceed 5, reckon 1 shilling more; and rejecting 5 in the second place, the figures in the second and third places are so many farthings, abating 1 for every 25.

	L.		s.	d.	f.
Examp. 1.	.718	=	14	4	2
2.	.759	=	15	2	1
3.	.894	=	17	10	3

In Example 1. the figure 7 doubled gives 14 s.; the two following figures 18 are farthings, equal to 4 d. 2 f.

In Example 2. the figure 7 doubled gives 14 s. and 5 in the place of seconds gives 1 shilling more, in all 15 s.; and the other figure 9 is farthings, *viz.* 2 d 1 f.

In Example 3. the figure 8 in the place of primes, and 5 in the place of seconds, give 17 s.; the remaining figures 44, abating 1, are farthings, *viz.* 10 d. 3 f.

When the figures in the second and third place to be converted into farthings are 25, the answer, by inspection, comes out exact, *viz.* 24 f. or 6 d.; but in all other cases, the answer, by inspection, is too great, no allowance or correction being made till the convertible number

number amount to 25, and afford a deduction of 1 farthing complete. Hence, by inspection, we have frequently 1 farthing more than by the common method; but the two methods will agree, or give the same answer, if, from the figures to be turned into farthings, we subtract their 25th part, esteeming the remainder farthings and decimal parts of a farthing.

Thus, .718 l. = 14s. 4d. 2f. by inspection; but by the common method, and by inspection corrected, the answer comes out 1 farthing less, as follows.

Common method.	*Inspection corrected.*
L.	If 25 : 1 :: 18 : .72.
.718	that is, 25)18.0(.72
20	175
s. 14.360	50 and 18
12	50 .72
d. 4.32	(0) 17.28
4	d. f.
f. 1.28	And 17.28 = 4 1.28

To conclude, instead of dividing by 25, we may multiply by .04; and then the exact value of any decimal of a pound Sterling may be found as follows.

From the primes and seconds set off the shillings; multiply the remainder by 4, setting the product two places to the right; subtract the product from the first remainder; and from the second remainder point off so many places to the right as there are figures in the first remainder. The number on the left of the point is farthings, and the figures on the right are a decimal of a farthing.

Example 1.	*Example* 2.
s. d. f.	s. d. f.
.718 l. = 14 4 1.28	.7691 l. = 15 4 2.336
1 Rem. .18	1 Rem. 191
72 = 18 × 4	764 = 191 × 4
2 Rem. 17.28	2 Rem. 18.336

PROB. V. To reduce a decimal to its primitive vulgar fraction.

CASE I. When the given decimal is finite.

RULE. Divide both numerator and denominator of the given decimal by their greatest common measure; the quot is the vulgar fraction required.

Thus, $.875 = \frac{875}{1000} = \frac{7}{8}$. For 875)1000(1
875

Greatest common measure 125)875(7
875

And $125)\frac{875}{1000}(\frac{7}{8}$. (0)

CASE II. When the given decimal is a pure repeater, or a pure circulate.

RULE. Make the repeating figure, or the figures of the circle, the numerator of the vulgar fraction; the denominator is 9 for the repeating figure, or 9 for every figure of the circle; and then, if occasion require, reduce this fraction to its lowest terms.

Thus, $.\dot{3} = \frac{3}{9} = \frac{1}{3}$, and $.\dot{6} = \frac{6}{9} = \frac{2}{3}$, and $.\dot{5} = \frac{5}{9}$.

Again, $.27, = \frac{27}{99} = \frac{3}{11}$, and $.714285, = \frac{714285}{999999} = \frac{5}{7}$.

CASE III. When the given decimal is a mixt repeater, or a mixt circulate.

RULE. From the mixt repeater, or mixt circulate, subtract the finite part, and the remainder is the numerator of the vulgar fraction; the denominator is 9 for the repeating figure, or 9 for every figure of the circle, with as many ciphers annexed as there are figures in the finite part.

Thus, $.0\dot{3} = \frac{3}{90} = \frac{1}{30}$, and $.1\dot{6} = \frac{15}{90} = \frac{1}{6}$, and $.08\dot{3} = \frac{75}{900} = \frac{5}{60} = \frac{1}{12}$.

The reason of the rule may be shewn thus: Esteem the finite part of the last example an integer, and then the mixt number $3\frac{571428}{999999}$ will be equal to the given circulate. Again, reduce this mixt number to an improper fraction, *viz.* multiply the integer 3 by the denominator 999999, and to the product add the numerator, as directed in reduction of vulgar fractions.

Multiply the integer 3 into 999999 by the method of multiplying any number by 9, 99, 999, &c. taught in multiplication of integers, and to the product add the numerator, and the sum shall be the numerator of the improper fraction, as in the margin.

3000000
3
2999997
571428
3571425 num.

Now it is evident that the same numerator will be found, if, in the upper line, instead of the six ciphers, you place the figures of the circle, and from them subtract 3, the finite part.

3571428
3
3571425 num.

To the numerator thus found, the denominator is 999999; and so the vulgar fraction is $\frac{3571428}{999999}$. But we esteemed 3 an integer; whereas, in fact, it is $\frac{3}{100}$; and so our vulgar fraction will be 100 times greater than it ought to be: to correct this error, we must multiply the denominator by 100, which is done by annexing two ciphers to it; and the true fraction comes out to be $\frac{3571428}{99999900}$, as by the rule.

Because this rule is of great importance, and will often occur in practice, we shall here subjoin another example.

Reduce $.041\dot{6}$ to a vulgar fraction.

$.041\dot{6}$
41
Num. 375
Den. 9000 $= \frac{1}{24}$.

In this manner too may any mixt number, consisting of an integer with a repeater or circulate, be reduced to an improper vulgar fraction; but no ciphers are to be annexed to the denominator for the figures of the integer.

Ex. Re-

Ex. Reduce 8.3 to an improper vulgar fraction.

$$\begin{array}{rl} & 8.3 \\ & 8 \\ \hline \text{Num.} & 75 \end{array}$$

$$\frac{75}{9} = \frac{25}{3} = 8\tfrac{1}{3}$$

Den. 9

Approximate decimals being imperfect, cannot be exactly reduced back to the vulgar fractions from which they resulted. But if the approximate be completed by annexing to it a vulgar fraction, whereof the remainder of the division is the numerator, and the divisor the denominator, you shall have a mixt number, which you may reduce to an improper vulgar fraction; then to the denominator annex as many ciphers as there are figures in the approximate; and this fraction reduced to its lowest terms, will be the primitive vulgar fraction required.

Prob. VI. To reduce unlike circles to others that are similar and conterminous.

Similar or like circles are such as consist of an equal number of places.

Thus, .27, and .09, are similar circles, as consisting of two places each. But .63, and .148, are unlike; the former consisting of two, and the latter of three places.

Conterminous circles are such as begin and end at the same distance from the decimal point.

Thus, .153846, and .384615, are conterminous; because they both begin at the place of primes, and have an equal number of places. And .0,714285, and .7,857142, are conterminous, because they both begin at the place of seconds, and have the same number of places. But .81, and .1,36, are not conterminous, the former beginning at the place of primes, and the latter at the place of seconds. Again, .63, and .481, are not conterminous, because they have not the same number of places; for circles cannot be conterminous unless they be at the same time similar.

Unlike circles are reduced to similar ones by the following

Rule. Find the least multiple of the numbers denoting the number of places in the several given circles, and extend each of the given circles to as many places as there are units in the least multiple.

.63, = .636363,
.148, = .148148,

Thus, to reduce the unlike circles .63, and .148, to similar ones, extend both circles to six places, because 6 is the least multiple of 2 and 3, the number of places in the given circles.

In a circle any one of the circulating figures may be made the first of the circle. Thus, 7.592, may be expressed thus, 7.5,925,; or thus, 7.59,259,; and that without changing its value: consequently a pure circulate may put on the form of a mixt circulate, if one or more figures on the left be set aside for the finite part; thus, .72,=.7,27, where .7, is the finite part.

That the value is not changed may be thus demonstrated.

$$.7,27, = \tfrac{720}{990} = \tfrac{72}{99} = .72.$$

Hence two or more given circles may be made conterminous, by the following

Rule. Set aside by a comma on the left, as many figures as there are places in the longest finite part, and then prolong the several circles to as many places as will make them similar.

Ex. To make .54,63, and .9,148, conterminous.

.54,63, = .54,636363,
.9,148, = .91,481481,

Here, because .54, the longest finite part, consists of two places, set aside .91, in the other circulate, for a finite part, and then prolong both circles to six places, which renders them similar.

III. *Addition of Decimals.*

Rule I. Place the given decimals so that the points may stand directly under each other, and consequently tenths under tenths, hundredths under hundredths *&c*.; then, if the given decimals be all finite or approximate, add them as integers, inserting the decimal point directly under the column of points. The figures on the left of the point are integers, and those on the right are a decimal of the integer, consisting of as many places as there are figures in the longest of the given decimals.

The operation is the same here as in addition of vulgar fractions; for a cipher on the right of a decimal does not change its value: If, therefore, ciphers be annexed, so as to give every decimal the same number of places, as is done in the margin, they will by this means be reduced to a common denominator, *viz.* 1000.

Ex.

.75	=	.750
.895	=	.895
.5	=	.500
.625	=	.625
.725	=	.725
3.495		$3\frac{495}{1000}$

Note, If the decimals to be added are of different denominations, first reduce them to one denomination, and then add. The reason is, because like things only can be added or subtracted.

Ex. What is the sum of .725 l. and .625 s.?

Here you may either reduce the decimal of a shilling to that of a pound, or you may reduce the decimal of a pound to that of a shilling.

First reduce the decimal of a shilling to that of a pound, by reduction-ascending, *viz.* divide by 20, as follows.

```
              L.
20).62500(.03125
          .725
       ———————   s.  d.
Sum   .75625 = 15   1½
```

Secondly, reduce the decimal of a pound to that of a shilling, by reduction-descending; that is, multiply by 20, as follows.

The answer here is the same as before.

```
      .725 l.
        20
    ———————
s.  14.500
       625
    ———————
s.  15.125 sum.
        12
    ———————
d.   1.500
         4
        —
f.   2.0
```

Approxi-

Approximates.

If the decimals to be added run on to a great many places, it will be ſufficient in moſt caſes to uſe only four or five places, and obſerve to increaſe the figure at which you break off by an unit, if the rejected figure on the right exceed 5. And in adding ſuch approximates, omit the right-hand figure of the ſum, as uncertain, but take in the carriage. Follows an example at large, and the ſame contracted.

Ex. at large.	*contracted.*
12.2352946	12.23529 +
8.15789325	8.15789 +
7.086968435	7.08696 —
6.32143482	6.32143 +
4.75	4.75
38.551591105	38.5515 certain.

Rule II. When all or any of the given decimals are repeaters, give every repeater the ſame number of places, and one place more than the longeſt finite; and for every nine in the right-hand column carry 1. or to its ſum add 1 for every nine, and then carry at ten.

Examp.

$$\begin{aligned} 748\tfrac{1}{3} &= 748.\cancel{3}3 \\ 653\tfrac{2}{3} &= 653.\cancel{6}6 \\ 84\tfrac{1}{9} &= 84.\cancel{1}1 \\ 25\tfrac{5}{6} &= 25.8\cancel{3} \\ 37\tfrac{5}{9} &= 37.\cancel{5}5 \\ 8\tfrac{1}{6} &= 8.1\cancel{6} \\ \hline 1557\tfrac{2}{3} &= 1557.\cancel{6}6 \end{aligned}$$

In this example the ſum of the right-hand column is 24, which contains 9 twice, and 6 over; ſo ſet down 6 and carry 2: Or to the ſum 24 add 2, for the two nines, which makes 26; ſo ſet down 6 and carry 2. Proceed with the reſt as in integers.

The ſums, differences, and products, of interminate decimals, are always interminate, unleſs they end in a cipher.

A repeating digit is the numerator of a vulgar fraction, whoſe denominator is 9; and hence, in adding a column of repeating digits, every 9 of the ſum is $\frac{9}{9}$, or an unit, to be carried; and what is over a juſt number of nines is ſo many ninth-parts.

Or, if to the ſum of a column of repeating digits, 1 for every 9 contained in it be added, we then carry 1 for every ten; but what is over a juſt number of tens will ſtill continue to be ninth-parts.

If in any example the repeating figures happen all to be reiterated, the carriage from the right-hand column adjuſts the column on the left, or makes every ten of them equal to an unit of the next ſuperior column, *&c.* Thus, if we imagine a column of the repeating figures reiterated on the right of any example, the carriage from it would adjuſt the right-hand column of the example.

Rule III. When all or any of the given decimals are circulates, make all the circles conterminous, find the number of tens to be carried from the left-hand column of the circles, add this carriage to the right hand column, and proceed as in addition of integers.

If repeaters be mixed with the circulates, give the repeaters the form of circulates, by extending the repeating figures till they become conterminous with the other circles.

If finite decimals are joined with the circulates, extend the finite parts of all the circulates to as many places as there are figures in the longeſt finite.

Examp.

$$\begin{aligned} \tfrac{3}{7} &= .428571, = .428571, \\ \tfrac{6}{7} &= .857142, = .857142, \\ \tfrac{5}{11} &= .45, \quad\;\; = .454545, \\ \tfrac{10}{27} &= .370, \quad\; = .370370, \\ & \qquad\qquad\quad \overline{\;2.110630\;} \end{aligned}$$

In order to find the carriage from the left-hand column of the circles, add the column next to it on the right, ſaying, $7+5+5+2=19$; from which carry 1, and ſay, $1+3+4+8+4=20$; from which carry 2, and go on to add the right-hand column of the circle, ſaying, the carriage $2+5+2+1=10$; ſo ſet down 0, and carry 1, and proceed with the reſt as in integers.

The adding the carriage from the left-hand column of the circles to the column on the right hand, ariſes from the flux of numbers; for as the circles repeat infinitely, if we ſuppoſe a new ſett of the ſame circles to be repeated upon the right of our examples, it is plain, that in adding them the carriage from the left-hand column of the new ſett would naturally fall into the right-hand column of our example.

The operation here is the ſame as in addition of vulgar fractions; for every circle is the numerator of a vulgar fraction, whoſe common denominator is 999999; and if the circles or numerators be added, without minding any carriage from the left-hand column, the ſum will be 2110628.

$$\text{And } 999999)2110628(2\tfrac{110630}{999999}$$
$$\underline{1999998}$$
$$110630$$

But, by pointing off from the ſum of the circles ſix figures towards the right, we divide by 1000000, inſtead of dividing by 999999; which gives indeed the ſame quot, but makes the remainder too ſmall.

Now, that the carriage-figure from the left-hand column of the circles, is the integral part of the quot, and at the ſame time the difference between the true and falſe remainder, is evident; for the quotient-figure 2, multiplied into the two diviſors 1000000 and 999999, gives two products, whoſe difference is 2; and conſequently, if the greateſt product, *viz.* $2 \times 1000000 = 2000000$, be ſubtracted from the dividend, the reſult will want 2 of the true remainder. To prevent ſuch errors, and to put the work on a ſure footing, find the carriage from the left-hand column of the circles, add this carriage to the right-hand column, divide the ſum by 1000000, and you will have a true quot, and a true remainder. The learner may look back to diviſion of integers.

integers, where the method of dividing by 9,99,999, *&c.* is explained.

.428571,	Hence it follows, that if we add the circles as they stand, without minding any carriage from the left, and to the sum add the excrescent figure on the left of the decimal point, we shall have the full sum of the circles, both as to the integral and fractional part, as in the margin.
.857142,	
.454545,	
.370370,	
2.110628	
2	
2.110630,	

Pure repeaters, being the numerators of vulgar fractions, whose denominator is 9 as often taken as the digit is repeated, may be added in the same manner as circles. But in examples clear of circulates, the method prescribed in Case II. is preferable.

.857142,	$.\dot{6}666$,
.571428,	$.\dot{6}666$,
.857142,	$.\dot{6}666$,
.714285,	1.9999,
2.999999,	1
1	2.0000
3.000000	

In adding circles and pure repeaters by the method now explained, it will sometimes happen that the fractional part of the sum will be a series of nines, as in the margin: And in this case, the numerator of the fraction being the same with the denominator, its value will be unity; and accordingly 1 must be added to the integral part. But in adding pure repeaters by the method in Case II. this cannot happen.

By way of proof, we shall here add all the vulgar fractions in Examp. I. and reduce their sum to a mixt number, continuing the division to a decimal.

$\frac{3}{7}+\frac{6}{7}+\frac{5}{11}+\frac{10}{27}=\frac{6237}{14553}+\frac{12474}{14553}+\frac{6615}{14553}+\frac{5390}{14553}=\frac{30716}{14553}$.

```
14553)30716(2.110630,
      29106
      -----
     * 16100
       14553
       -----
        15470
        14553
        -----
          91700
          87318
          -----
          43820
          43659
          -----
         *16100
```

Here the dividual being the same with the second, a new circle begins.

IV. *Subtraction of Decimals.*

Rule I. Place the minor under the major, so that that the points may be in one column; and then, if the given decimals be finite or approximate, work as in subtraction of integers.

If the major and minor have not the same number of places, imagine the void places to be filled up with ciphers.

Example I.

	L.	*s.*	*d.*	*L.*
From	48	10	6	=48.525
Sub.	18	12	$8\frac{1}{4}$	=18.634375
Rem.	29	17	$9\frac{3}{4}$	=29.890625

Example II.

	C.	*Q.*	*lb.*	*C.*
From	54	2	21	=54.6875
Sub.	36	3	14	=36.875
Rem.	17	3	17	=17.8125

Approximates.

In subtracting approximates, neglect the right-hand figure of the remainder, as uncertain; but an unit borrowed on the right must be repaid, as in the two examples following.

	Ex. 1.			*Ex. 2.*	
From	783.0625		From	549.4643	
Sub.	495.28571 +		Sub.	78.0875	
Rem.	287.7767	certain.	Rem.	471.376	certain.

Rule II. If one of the given decimals is a repeater, and the other a finite decimal, give the repeater one place more than the finite decimal, and in subtracting borrow 9 on the right hand.

But if both major and minor repeat, give them an equal number of places, and then subtract as above.

	Ex. 1.	*Ex. 2.*	*Ex. 3.*
From	$.71458\dot{3}3$	.525	$.998958\dot{3}$
Sub.	.634375	$.\dot{8}333$	$.02916\dot{6}6$
Rem.	$.080208\dot{3}$	$.191\dot{6}$	$.969791\dot{6}$

In Ex. 1. and 2. you give the repeater one place more than the finite decimal, and by this means you obtain the repeating figure of the remainder. But in Ex. 3. you give the two repeaters an equal number of places.

In Ex. 2. and 3. you borrow 9 on the right hand.

Rule III. If both the given decimals be circulates, make the circles conterminous, and work as in integers; only if, in the left-hand column of the circles, you foresee, that, in subtracting the figure of the minor from that of the major, one must be borrowed, in this case add 1 to the right-hand figure of the minor, and then subtract.

If one of the given decimals be a circulate, and the other a repeater, give the repeater the form of a conterminous circulate, and then subtract as above.

If one of the given decimals be a circulate, and the other a finite decimal, extend the finite part of the circulate to as many places as there are figures in the finite decimal, and then subtract.

Examp. I. From $\frac{9}{14}$=.6,428571, =.64,285714,
Sub. $\frac{5}{28}$=.17,857142,=.17,857142,

Rem. .46,428571,

In this example, because, in the left-hand column of the

the circles, 8 cannot be subtracted from 2 without borrowing; therefore add 1 to the right-hand figure of the minor, and say, 1+2=3, and 3 from 4, and 1 remains. The reason is obvious: for, supposing the circles reiterated on the right of the example, it would be, 8 from 2 you cannot, but 8 from 12 and 4 remains; 1 borrowed, and 2, make 3, &c.

EXAMPLE II.

From $\frac{13}{14}$=.9,285714,=.9,285714,
Sub. $\frac{2}{3}$=.$\dot{6}$ =.$\dot{6}$,666666,

Rem. .2,619047,

In the above example the repeaters are given in the form of conterminous circulates.

EXAMPLE III.

From $\frac{5}{13}$=.384615,=.384,615384,
Sub. $\frac{1}{8}$=.125 =.125

Rem. .259,615384,

In the last example the finite part of the circulate is extended to as many places as there are figures in the finite decimal, by which means like things come to be subtracted, and you obtain the exact circle of the remainder.

V. *Multiplication of Decimals.*

IN multiplication and division there may happen nine varieties, arising from the different nature of the numbers that may occur in the operation; and these are of three sorts, *viz.* integers, mixt numbers, and pure decimals.

Now, since the multiplier or divisor may be of three kinds, and the multiplicand or dividend of as many, there must of consequence be nine varieties; which are these following.

An integer may multiply or divide $\begin{cases}\text{an integer,}\\ \text{a mixt number,}\\ \text{a pure decimal.}\end{cases}$

A mixt number may multiply or divide $\begin{cases}\text{an integer,}\\ \text{a mixt number,}\\ \text{a pure decimal,}\end{cases}$

A pure decimal may multiply or divide $\begin{cases}\text{an integer,}\\ \text{a mixt number,}\\ \text{a pure decimal.}\end{cases}$

Of these varieties, the first belongs properly to vulgar arithmetic, the other eight occur in decimal operations.

But in multiplication and division of decimals, there will occur other nine varieties, arising likewise from the nature of the numbers; which may either be finite, repeating, or circulating.

And since the multiplier or divisor may be of three sorts, and the multiplicand or dividend of as many, there must of course be nine varieties; and these are so obvious, that it would be losing time here to enumerate them.

Before entering on multiplication, we shall lay down a rule for pointing the product, which is of a general nature, and extends to decimals of every sort, whether finite, repeating, or circulating; and is as follows.

GENERAL RULE.

Give so many decimal places to the product, on the right, as are in both factors; and if the product has not so many figures, supply that defect by prefixing ciphers.

We now proceed to multiplication.

RULE I. If both factors are finite or approximate, work exactly as in multiplication of integers.

Ex. 1.	*Ex.* 2.
.785	.125
.75	.25
3925	625
5495	250
.58875	.03125

In Ex. 2. the product not affording so many decimal places as are in the multiplicand and multiplier, the defect is supplied by prefixing ciphers.

The reason of giving as many decimal places to the product as are in both factors, appears by considering that the operation is the same here as in multiplication of vulgar fractions. Thus, $.785 \times .75 = \frac{785}{1000} \times \frac{75}{100} = \frac{58875}{100000} = .58875$.

To multiply by 10, 100, 100, &c. move the decimal point so many places toward the right hand as there are ciphers in the multiplier.

Thus:	And thus:
.4375 × 10 = 4.375	6.875 × 10 = 68.75
.4375 × 100 = 43.75	6.875 × 100 = 687.5

APPROXIMATES.

In multiplying approximates, the certain places of the product may be determined by one or other of the two rules following, *viz.*

1. If both factors are approximates, the uncertain places of the product will be one more than the number of places in the longest factor.

2. If one of the factors be finite, and the other approximate, the uncertain places of the product will be one more than the number of places in the finite factor.

Ex. 1.	*Ex.* 2.
245.118—	.210526+
.3529+	2.875
2206062	1052630
490236	1473682
1225590	1684208
735354	421052
86.5021422	.605262250

In Ex. 1. the integral part of the product, *viz.* 86, is certain, and all the decimal places on the right are uncertain. In Ex. 2. only four places on the left, *viz.* .6052, are certain, and all the other places uncertain.

The reason of Rule 1. is plain. For if in Ex. 1. we make the longest factor the multiplier, and the total product will be the same either way, it is obvious, that in this case we shall have six particular products, in each of which the right-hand figure will be uncertain, and consequently

consequently we ſhall have ſix uncertain places in the total product toward the right, and alſo one uncertain place more on account of the uncertain carriage from the column in which the right-hand figure of the laſt particular product ſtands.

The reaſon of Rule 2. is alſo obvious. For in Ex. 2. by making the finite factor the multiplier, we have four particular products, in each of which the right-hand figure is uncertain; and ſo we have four uncertain places in the total product, and one uncertain place more ariſing from the uncertain carriage.

The carriage in ſome caſes may affect ſeveral columns on the left, and thereby render ſo many more figures uncertain.

The ſureſt way therefore to determine the certain places in the product of approximates, is by a ſecond operation, giving the approximates contrary ſigns; for then, ſo far as the two products agree, the figures are certain. The ſecond operations of the two former examples follow.

Ex. 1.	*Ex.* 2.
245.117+	.210527−
.353−	2.875
735351	1052635
1225585	1473689
735351	1684216
	421054
86.526301	.605265125

In Ex. 1. 86.5 is certain, and all the other figures uncertain. In Ex. 2. .60526 are the only certain places.

Becauſe the multiplication of decimals that conſiſt of many places, proves, in the way hitherto practiſed, a tedious operation, we ſhall here explain a method whereby decimals of this ſort, whether finite or approximate, may be multiplied expeditiouſly, and at the ſame time have the decimal places in the product limited to any number propoſed. This may be effected by the following

Rule. Under the multiplicand place the multiplier inverted, ſo that its units place may ſtand under that place of the multiplicand to which you propoſe to limit the product; then multiply the right-hand figure of the multiplier into that figure of the multiplicand which ſtands directly over it, taking in the carriage from the right, and go on to multiply it into all the other figures on the left. Proceed in like manner with every other figure of the multiplier, placing the right-hand figures of all the particular products directly under other. The total product will be approximate, and the right-hand figure uncertain.

To make this rule more eaſily underſtood, the reader may look back to the multiplication of integers; where it was obſerved, that inſtead of beginning with the right-hand figure of the multiplier, we may begin with the left, and ſtill have a juſt product, provided the right-hand figure of every particular product be placed directly under the multiplying figure. Now, the working an example, both in this manner, and alſo by the rule, and comparing the ſteps and reſults of the two operations, will throw a light upon the matter, and unfold the reaſon of the rule. Which take as follows.

Multiply 18.634375 into 9.875, and limit the product to four decimal places.

By the rule.	By the other method.
18.634375	18.634375
578.9	A 9.875
1677093	1677093|75
149075	149075|000
13044	13044|0625
931	931|71875
184.0143+	184.0144|53125
	B

In working by this rule, you invert the multiplier, and place 9, the units figure, under 3, the fourth place of decimals, becauſe the product is limited to four decimal places; then multiply, ſaying, $9\times3=27$, and 6 carried from the right makes 33, *&c.* In multiplying by 8, ſay, $8\times4=32$, and 3 of carriage makes 35; ſo ſet 5 under 3; and proceed in like manner to multiply the figures on the left. The right-hand figure of the product is defective, as wanting the carriage from the columns cut off on the right by the line A B. The figures expreſſing the ſum of the columns ſo cut off, are ſo many uncertain places of the product, when the factors are approximate, and on that account to be rejected as uſeleſs. The figures, moreover, on the right of the line A B, ſhow how far the operation is contracted, or how much labour is ſaved in working by the rule.

If there be no units in the multiplier, in this caſe ſet the right-hand figure of the inverted multiplier under that figure of the multiplicand, below which it would have ſtood had there been units.

Ex. Multiply .825 by .825, limiting the product to three decimal places.

By the rule.	The common way at large.
.825	.825
528.	.825
660	4|125
16	16|50
4	660|0
.680+	.680|625

The decimal places of the factors may either be retained at full length, or turned into approximates before you begin to multiply.

Ex. Multiply 25.8490136 25 by 42.97235, limiting the product to two decimal places.

25.849013625
53279.24
103396
5169
2326
180
5
1110.76+

We

We shall next turn the decimals of the former example into approximates, and then the operation will be as follows.

By the rule.	Common way at large.
25.85—	25.85—
+79.24	42.97+
103400	18095
5170	23265
2326	5170
180	10340
Prod. 1110.76+	1110.7745

It remains to be observed, that the want of carriage from the right hand may sometimes affect more columns on the left than one, and thereby occasion more uncertain figures in the product than that on the right hand. The best security on this head is, never to limit the product to fewer than four or five decimal places.

To conclude, when decimals to be multiplied are long, you may frequently perform the operation more easily in vulgar fractions, and then reduce the product to a decimal.

Rule II. If the multiplier be finite, and the multiplicand repeat, in multiplying carry at 9 on the right hand; and before you add, prolong the repetends of the particular products, till their right-hand figures stand directly under one another; and in adding, carry at 9 on the right hand.

The product repeats, as in Ex. 1. 2. *&c.*; or turns out finite, as in Ex. 6.

Ex. 1.	*Ex.* 2.	*Ex.* 3.	*Ex.* 4.
$.\dot{3}$	$.1\dot{6}$	$27.08\dot{3}$	$354.2\dot{6}$
4	7	.5	.08
$1.\dot{3}$	$1.1\dot{6}$	$13.541\dot{6}$	$28.341\dot{3}$

Ex. 5.	*Ex.* 6.
$4.0\dot{6}$	$6.4\dot{3}$
5.2	123
$81\dot{3}$	1930
20333	$1286\dot{6}$
$21.14\dot{6}$	64333
	791.30

Note, If the multiplier has ciphers on the right, instead of annexing ciphers to the product, reiterate its right-hand figure so many times as there are ciphers.

Ex. 1.	*Ex.* 2.
$79.\dot{6}$	$874.\dot{3}$
50	900
$3983.\dot{3}$	786900.0

Rule III. If the multiplier be finite, and the multiplicand circulate, to the product of the right-hand figure of the circle add the carriage from the left, then proceed as in multiplication of integers; but before you add the particular products, make them conterminous, and then add as in addition of circulates.

The product commonly circulates; and then its circle is similar to the circle of the multiplicand, as in Ex. 1. and 2.; but the product sometimes repeats, as in Ex. 5.; or it may turn out finite, as in Ex. 6.

Here it is obvious, that in multiplying .481 by 7, the carriage from the left would be 3; so say, $7 \times 1 = 7$, and 3 of carriage, make 10, *&c.* The product circulates, and its circle .370, is similar to .481, the circle of the multiplicand.

Ex. 1.
.481,
7,
3.370,

Ex. 2.	*Ex* 3.	*Ex.* 4.
7.518,	7.518,	7.518,
.5	.05	.005
3.7,592,	.37,592,	.037,592,

In the above three examples the products are mixt circulates, the three figures on the right being the circle, and the figures on the left the finite parts.

Rule IV. If the multiplier be interminate, reduce it to a vulgar fraction, as directed in reduction of decimals, Prob. V.; then multiply the given multiplicand by the numerator, (working as in integers, if the multiplicand be finite; or as directed in Rule 2. if it repeat; or as prescribed in Rule 3. if it circulate); and divide the product by the denominator.

Here there are six cases; for the multiplier may repeat or circulate, and may multiply a finite, a repeating, or circulating multiplicand.

Case I. When a repeating multiplier multiplies a finite multiplicand.

Examp. Multiply 638.25 by $.\dot{4} = \frac{4}{9}$

```
       638.25
            4
   -----------
   9)2553.00(283.6 product sought.
     18
     --
      75
      72
      --
       33
       27
       --
        60
        54
        --
        *6
```

Case II. When both factors repeat.

Examp.

EXAMP. Multiply $6.8\dot{3}$ by $.\dot{7}=\frac{7}{9}$

```
   6.83
      7
   ----
9)47.83(5.3,148, prod.
  45
  --
   28
   27
   --
   *13
     9
    --
     43
     36
     --
      73
      72
      --
      * 1
```

In dividing by 9, after the dividend is exhauſted, continue the diviſion by annexing to the remainders the repeating figure of the dividend; and the quot or product ſought comes out a mixt circulate.

CASE III. When a repeating multiplier multiplies a circulating multiplicand.

EXAMP. Multiply 24.36, by $.\dot{4}=\frac{4}{9}$

```
   24.36,
       4
   -----
9)97.45,(10.82, prod.
  9
  --
 * 74
   72
   --
    25
    18
    --
  * 74
```

In multiplying by 4, take in the carriage from the left of the circle; and in dividing by 9, continue the diviſion by annexing to the remainders the circulating figures of the dividend.

CASE IV. When a circulate multiplies a finite multiplicand.

EXAMP. Multiply 825 by $.36,=\frac{36}{99}$

```
     825
      36
    ----
    4950
   2475
   -----
99)29700(300 product
   297
```

CASE V. When a circulate multiplies a repeating multiplicand.

EXAMP. Multiply $8.0208\dot{3}$ by $.72,=\frac{72}{99}$

```
      8.02083
           72
     --------
      1604166
     56145833
     --------
99)577.50000(5.83
   495
   ---
    825
    792
    ---
     330
     297
     ---
    * 33
```

CASE VI. When both factors circulate.

EXAMP. Multiply .714285, by $.36,=\frac{36}{99}$

```
      .714285,
           36
     ---------
      4,285714,
     21,428571,
     ----------
  99)25,714285,7
        257142,8
          2571,4
            25,7
     ----------
Prod. .25,974025,=.259740.25
```

The circle of the firſt product is always ſimilar to that of the multiplicand, and in the above example conſiſts of ſix places; but to ſecure the carriage from right to left, and thereby complete the circle of the quot or total product, transfer 7, the left-hand figure of the circle of the firſt product, to the right, and fill up the places under it with the figures that come in courſe, and from the ſum of theſe figures on the right carry 2, which completes the circle of the total product.

VI. *Diviſion of Decimals.*

BEFORE we enter on diviſion, it will be proper to obſerve, that there are two rules for pointing the quot, both which are general in their nature, and extend to decimals of every ſort, whether terminate or interminate; but unwilling to perplex the learner with too many things at once, we ſhall at preſent lay down only one of theſe rules; and afterwards, when the rule now to be aſſigned appears to be ſufficiently exemplified, ſhall then bring the other rule upon the field.

GENERAL RULE.

The decimal places in the diviſor and quot together muſt always be equal in number to thoſe of the dividend.

The

The five following practical directions will make the application of the general rule easy.

1. When the divisor and dividend have an equal number of decimal places, the quot comes out an integer; as in Ex. 2.

2. When the decimal places of the dividend are more than those of the divisor, the number of decimal places in the quot must be equal to the excess; as in Ex. 1. 4. and 8.

3. When the decimal places of the divisor are more than those of the dividend, annex ciphers to the dividend, so as to make them equal, and the quot, by direction 1. will be integers; as in Ex. 3. 5. and 7.

4. When, after division is finished, the quot has not so many figures, as, by the general rule, it ought to have decimal places, supply that defect by prefixing ciphers; as in Ex. 6.

5. If, after the dividend is exhausted, there be a remainder, annex a cipher, or ciphers, to the remainder, and continue the division till 0 remain, or till the quot repeat or circulate, or till you think proper to limit it; as in Ex. 9. 10. 11. and 12.

We now proceed to division.

Rule I. If the divisor and dividend are both finite or approximate, work exactly as in division of integers.

Ex. 1.

```
.75).58875(.785
     525
     ---
      637
      600
      ---
       375
       375
```

Ex. 2.

```
2.5)182.5(73
    175
    ---
      75
      75
```

In Ex. 1. A decimal divides a decimal; and because the dividend has five decimal places, and the divisor only two, give three decimal places to the quot, according to Direction 2.

In Ex. 2. A mixt number divides a mixt number, and the divisor and dividend having an equal number of decimal places, the quot comes out an integer, according to Direction 1.

The reason of the rule for pointing the quot is obvious; for multiplication gives as many decimal places to the product as are in both factors; but the dividend is the product of the divisor and quot, and so has as many decimal places as are in both; consequently the decimal places in the divisor and quot together must be equal in number to those of the dividend.

Ex. 3.

```
.85)476(
.85)476.00(560
    425
    ---
     510
     510
     ---
       0
```

Ex. 4.

```
7).875(.125
   7
   --
   17
   14
   --
    35
    35
```

In Ex. 3. A decimal divides an integer; and the dividend having no decimal place, annex two ciphers, because there are two decimal places in the divisor, and the quot comes out an integer, according to Direction 3.

In Ex. 4. An integer divides a decimal; and because the dividend has three decimal places, and the divisor none, give the quot three, by Direction 2.

Ex. 5.

```
.375)12.75(
.375)12.750(34
     1125
     ----
      1500
      1500
```

Ex. 6.

```
2.5).22875(.0915
     225
     ---
       37
       25
       --
       125
       125
```

In Ex. 5. A decimal divides a mixt number; and the divisor having three decimal places, and the dividend but two, supply that defect by annexing a cipher, and the quot comes out an integer, by Direction 3.

In Ex. 6. A mixt number divides a decimal; and because the dividend has four decimal places more than the divisor, and the quot, after the divsion is finished, has only three figures, supply this defect by prefixing a cipher to it, according to Direction 4.

Ex. 7.

```
3.75)180(
3.75)180.00(48
     1500
     ----
      3000
      3000
```

Ex. 8.

```
38)243.2(6.4
   228
   ---
    152
    152
```

In Ex. 7. A mixt number divides an integer; and the dividend having no decimal places, supply that defect by annexing two ciphers, the number of decimal places in the divisor, and the quot is an integer, by Direction 3.

In Ex. 8. An integer divides a mixt number; and the divisor having no decimal place, and the dividend only one, give one to the quot, according to Direction 2.

Ex. 9.

```
.8)29(36.25
   24
   --
    50
    48
    --
     20
     16
     --
      40
      40
```

Ex. 10.

```
.018).0024(.13
      18
      --
       60
       54
       --
       *6
```

In Ex. 9. A decimal divides an integer; and after the dividend is exhausted, annex a cipher to the remainder, and continue the division till 0 remain, according to Direction 5.

In Ex. 10. A decimal divides a decimal; and after the dividend is exhausted, annex a cipher to the remainder, and continue the division till you find the quot repeats.

```
Ex. 11.
11)8(
11)8.0(.72
   77
   ---
   30
   22
   --
   *8
```

```
Ex. 12.
3.25)76.75(23.615+
     650
     ---
     1175
     975
     ----
     2000
     1950
     ----
      500
      325
      ---
     1750
     1625
     ----
      125
```

In Ex. 11. An integer divides an integer; and the dividend being leſs than the diviſor, annex a cipher to it; again, after the dividend is exhauſted, annex a cipher to the remainder, and continue the diviſion till you find the quot circulates.

In Ex. 12. A mixt number divides a mixt number: and after the dividend is exhauſted, by annexing ciphers to the remainder, continue the diviſion till the quot has three decimal places; and as there is ſtill a remainder, it might be carried further; but three decimal places being in moſt caſes ſufficiently accurate, here you may limit it; ſo the quot is approximate.

In diviſion of decimals, the place of the firſt figure of the quot may likewiſe be known from the firſt dividual, much after the ſame manner as in diviſion of integers, by the following

II. General Rule.

The place of the firſt figure of the quot is the ſame with the place of that figure in the dividend which ſtands over the units of the firſt product.

Thus, in the example of integers in the margin, the figure 0, that ſtands over 5, the units of the product of 9×35, is in the place of hundreds; and therefore 9, the firſt figure of the quot, is likewiſe hundreds; and ſo the quot is 917 integers.

```
35)32095(917
   315
   ---
    59
    35
    --
    245
    245
```

To illuſtrate the rule, we ſhall give decimal places to the dividend of the above example; and thereby exhibit the varieties that will occur in pointing the quot.

```
Variety 1.
35)3209.5(91.7
   315 .
   ---
    59
    35
    --
    245
    245
```

```
Var. 2.
35)320.95(9.17
   315 ..
   ---
    59
    35
    --
    245
    245
```

```
Var. 3.
35)32.095(.917
   315 ..
   ---
    59
    35
    --
    245
    245
```

```
Var. 4.
35)3.2095(.0917
   315 ..
   ---
    59
    35
    --
    245
    255
```

```
Var. 5.
35).32095(.00917
   315 ..
   ---
    59
    35
    --
    245
    245
```

```
Var. 6.
35).032095(.000917
    315 ..
    ---
     59
     35
     --
     245
     245
```

In all the above varieties, the figure 0 in the dividend ſtands over the units of the firſt product: and in Var. 1. the figure 0 is in the place of tens, and accordingly 9, the firſt figure of the quot, is tens; in Var. 2. the figure 0 is in the place of units, and ſo 9 is units; in Var. 3. the figure 0 is in the place of primes, and ſo 9 is primes, *&c.*

Here obſerve that 9, the firſt ſignificant figure of the quot, in all the above varieties, as well as in the varieties that follow, muſt always be conſidered, in multiplying the diviſor, as an integer; and, in pointing the firſt product, no decimal place is to be allowed for it.

We ſhall now keep the dividend an integer, and give decimal places to the diviſor.

```
Var. 1.
3.5)32095(9170
    31.5..
    ----
     59
     35
     --
     245
     245
     ---
     0.0
```

```
Var. 2.
.35)32095(91700
    3.15..
    ----
     59
     35
     --
     245
     245
     ---
     0.00
```

```
Var. 3.
.035) 32095(917000
      0.315..
      -----
       59
       35
       --
       245
       245
       ---
       0.000
```

```
Var. 4.
.0035) 32095(9170000
       0.0315..
       ------
        59
        35
        --
        245
        245
        ---
        0.0000
```

In Var. 1. ſay, $9\times3.5=31.5$; and the unit 1 ſtanding under the place of thouſands, the figure 9 is alſo thouſands; and as 0 at laſt remains, annex a cipher for the decimal .5 in the diviſor; then dividing, you get 0 to the quot; and becauſe 9 ſtands in the place of thouſands, the quot is wholly integers.

In

In Var. 2. the unit 3 ſtands under the place of ten-thouſands, and ſo 9 is ten-thouſands; and to the remainder 0 annex .00, for the two decimal places in the diviſor; then dividing, you get 00 to the quot; and becauſe 9 ſtands in the place of ten-thouſands, the quot continues to be wholly integers. The proceſs is the ſame in Var. 3. and 4.

Laſtly, we ſhall allow decimal places to both dividend and diviſor.

Var. 1.	*Var.* 2.
3.5)320.95(91.7	3.5)32.095(9.17
31.5..	31.5..
59	59
35	35
245	245
245	245
Var. 3.	*Var.* 4.
.35).32005(.917	3.5).32095(.0917
3.15..	31.5..
59	59
35	35
245	245
245	245

In Var. 1. the units of the firſt product ſtand under tens of the dividend; and ſo 9, the firſt figure of the quot, is tens. In Var. 2. the units of the firſt product ſtand under units of the dividend, and ſo 9 is units. In Var. 3. the units of the firſt product ſtand under primes, and ſo 9 is primes, *&c.*

To divide by 10, 100, 1000, *&c.* is to move the decimal point one place toward the left for every cipher in the diviſor.

Thus,	And Thus,
10)768(76.8	10)17.28(1.728
100)768(7.68	100)17.28(.1728
1000)768(.768	1000)17.28(.01728
10000)768(.0768	10000)17.28(.001728

APPROXIMATES.

In dividing approximates, the certain places of the quot may be determined by the following

RULE. Place the diviſor under the firſt dividual, and the number of certain figures in the quot ſhall be one leſs than the number of places from the left of the diviſor to the firſt + or —, whether in the diviſor or in the dividend.

Ex. 1.	*Ex.* 2.
Dividend 1110.79286078—	Dividend 1110.7929—
Diviſor 42.9723+	Diviſor 25.8490136+
Certain places five, whereof three are decimals.	Certain places ſix, whereof four are decimals.

But here it is to be obſerved, that the uncertain carriage may, in ſome caſes, effect ſeveral columns on the left, and thereby render more figures of the quot uncertain than the rule preſcribes. The ſureſt way, therefore, is, to make two operations with contrary ſigns, and then the figures in which the two quots agree are certain.

In order to make the reaſon of the rule appear, it will be neceſſary to work an example.

Example.

```
                       A
42.9723+)1110.79|286078—(25.849.
             85944|6....
             -----|----
             25134|68
             21486|15
             -----|----
              3648|536
              3437|784
              ----|----
               210|7520
               171|8892
               ---|----
                38|86287
                38|67507
                --|-----
                  |18780
                  B
```

Here we ſtop, no more places being certain. The reaſon is obvious; for the right-hand figure of the firſt product, *viz.* 6, is uncertain; and conſequently all the figures under it, on the right of the line A B, will be ſo too; that is, the laſt remainder and new dividual are uncertain, and of courſe the figure that would go next to the quot.

From this example it appears, that all the figures on the right of the line A B are uncertain and uſeleſs; if therefore a way of working, without writing down theſe uſeleſs figures, can be found, we ſhall then have a method of dividing long decimals, whether finite or approximate, ſo as to contract the operation, and limit the product to any number of decimal places propoſed. And this may be effected by obſerving the following

RULE. Write the product of the firſt quotient-figure under the dividend; and from the ſituation of the units place, conſider how many figures of the dividend muſt be retained to give the quot the number of decimal places intended; cut off the other figures on the right, and alſo the figures correſponding to them on the right of the diviſor; then ſubtract; eſteem this and every following remainder a new dividual; and for each new dividual drop a figure on the right of the diviſor; but in multiplying the quotient-figures into the diviſor, take in the carriage from the right hand; as in the following examples.

Ex. I. Divide 95.4327564632 75 by 3.4637528; and limit the quot to four decimal places.

Contracted

Contracted by the rule.

```
3.46375|28)95.4327|56463275(27.5518
 .....     6.92750|56
           -------
           261577
           242462
           ------
            19115
            17318
            -----
             1797
             1731
             ----
               66
               34
               --
               32
               27
               --
              (5)
```

In the above example the units of the first product standing under the place of tens, the first figure of the quot is tens; and hence it is easy to foresee, that six figures of the dividend retained will give four decimal places to the quot; and accordingly cut off all the other figures on the right of the dividend; cut off likewise from the divisor two figures that correspond to them.

At every new dividual, drop or omit a figure on the right of the divisor, and mark the figure so dropped by setting a point under it; and in multiplying the quotient-figure 7 into the divisor, say, 7 times 7 is 49, and 3 of carriage from the right, (arising from $7\times5=35$), makes 52; so set down 2, and carry 5. The same method is observed in multiplying every other quotient-figure into the divisor.

The same Example at large.

```
                       A
3.4637528)95.4327|56463275(27.55183
           6.92750|56.......
           -------------
           261577|004
           242462|696
           -------------
            19114|3086
            17318|7640
            -------------
             1795|54463
             1731|87640
             -------------
               63|668232
               34|637528
               -------------
               29|0307047
               27|7100224
               -------------
                1|32068235
                1|03912588
               -------------
                 |29055647
                 B
```

In working the same example at large, the line A B shows how far the operation is contracted, and how much labour is saved.

But here observe, that by the rule for approximates the certain places of the quot are no more than five, *viz.* 27.551. And therefore, in all operations of this kind, care should be taken to limit the quot to so many places certain; as is done in the following example.

Examp. II. Divide 87.0763264525 by 9.365407024; limiting the quot to four decimal places certain.

```
9.36540|7024)87.07632|64525(9.2976
 .....       84.28866|3216
             ---------
              278766
              187308
              ------
               91458
               84288
               -----
                7170
                6555
                ----
                 615
                 561
                 ---
                  54
```

Here we put a stop to the operation; because, by the rule for approximates, the next figure of the quot would be uncertain.

We shall conclude division of finite decimals with two very useful problems.

Prob. I. From a given multiplier to find a divisor that gives a quot equal to the product.

Rule. Divide an unit with ciphers annexed by the given multiplier, and the quot will be the divisor sought.

Examp. What divisor will give a quot equal to the product of 125 into the dividend?

Given multiplier 125)1.000(.008 divisor sought.

1000

Now, if any number be divided by .008, and the same number be multiplied by 125, the quot and product will be equal.

```
.008)7315.000(914375 quot.
     72......
     --
      11                7315
       8                 125
      --               ------
       35              36575
       32             14630
       --             7315
        30            ------
        24            914375 product.
        --
         60
         56
         --
          40
          40
```

The reason is plain: for an unit contains the quot .008 just 125 times; and consequently .008 dividing any number

ber will give a quot 125 times greater than the dividend; that is, the quot will be equal to the product of the dividend multiplied by 125.

PROB. II. From a given divisor to find a multiplier that gives a product equal to the quot.

RULE. Divide an unit with ciphers annexed by the given divisor, and the quot will be the multiplier sought.

EXAMP. What multiplier will give a product equal to the quot arising from the same number divided by .008?

Given divisor .008)1.000(125 multiplier sought.
8 · ·
—
20
16
—
40
40

Now, if any number be multiplied by 125, and the same number be divided by .008, the product and quot will be equal; as appears in the example following.

785
125
——
3925
1570
785
——
98125 product

.008)785.000(98125 quot.
72
—
65
64
—
10
8
—
20
16
—
40
40

RULE II. If a finite divisor divide a repeating dividend, work as in integers; but in continuing the division, instead of annexing ciphers to the remainder, annex the repeating figure of the dividend.

Ex. 1.
5).33(.06
30
—
*3

Ex. 2.
4)5.16(1.2916
4
—
11
8
—
36
36
—
6
4
—
26
24
—
*2

RULE III. If a finite divisor divide a circulating dividend, work as in integers; but in continuing the division, instead of annexing ciphers to the remainder, annex the circulating figures of the dividend.

Ex. 1.
7)3.370,(.481,481,
28 · ·
—
57
56
—
10
7
—
*33
28
—
57
56
—
10
7
—
*3

Ex. 2.
.5)3.7,592,(7.518,5
3.5 · · · ·5
—— ——
*25 3,7,592, proof.
25
—
9
5
—
42
40
—
*25

RULE IV. If the divisor be interminate, reduce it to a vulgar fraction, as taught in reduction of decimals, Prob. V.; then multiply the given dividend by the denominator, and divide the product by the numerator.

Here there are six cases; for the divisor may either repeat or circulate, and may divide a finite, a repeating, or circulating dividend.

CASE I. When a repeating divisor divides a finite dividend.

EXAMP. Divide 23.5 by $.4 = \frac{4}{9}$

9
——
4)211.5(52.875
20
—
11
8
—
35
32
—
30
28
—
20
20

CASE II. When a repeating divisor divides a repeating dividend.

EXAMP. Divide 43.26 by $.3 = \frac{3}{9}$

43.26
9
——
3)389.40(129.8
3 · · · quot.
——
8
6
—
29
27
—
24
24

Or rather thus:

432.66
43.26
——
3)389.40(129.8

CASE. III. When a repeating divifor divides a circulate.

EXAMP. Divide 92.518, by $.4 = \frac{4}{9}$

```
 92.518,      Or rather thus :  925.185,
      9                           92.518,
 -------                        ---------
 832.666                        4)832.666(208.16
                                  8····
                                  ---
                                  32
                                  32
                                  ---
                                    6
                                    4
                                    --
                                    26
                                    24
                                    --
                                    *2
```

CASE IV. When a circulate divides a finite dividend.

EXAMP. Divide 9 by $.45 = \frac{45}{99}$

```
   900
     9
   ----
45)891(19.8
   45·
   ---
   441
   405
   ---
    360
    360
```

In order to multiply the dividend 9 by 99, firft multiply it by 100, which is done by annexing two ciphers; and from this product fubtract the dividend.

CASE V. When a circulate divides a repeating dividend.

EXAMP. Divide 5.83 by $.72, = \frac{72}{99}$

```
   583.33
     5.83
   ------
72)577.50(8.0208З
   576
   ---
     150
     144
     ---
      600.
      576
      ---
       240
       216
       ---
       *24
```

In order to multiply the dividend by 99, move the decimal point two places to the right, and then fubtract the given dividend.

CASE VI. When a circulate divides a circulate.

EXAMP. Divide .962, by $.18, = \frac{18}{99}$

```
    96.296,
      .962,
    --------
 18)95.333(5.296,
    90···
    ---
    *53
     36
     ---
     173
     162
     ---
      113
      108
      ---
       *5
```

When the circle of the quot is likely to run on to many places, you may ftop the operation, and complete the quot by a vulgar fraction; as in the following example.

EXAMP. Divide 34.56097, by $3.592, = \frac{3589}{999}$

```
3.592,)34560.97560,
     3   34.56097,
 -----   ----------
3589) 34526.41463,(9.6200653 (2724 46341/99999)/3589
      32301····
      -----
       22254
       21534
       -----
         7201     Or, 9.6200653 272443617/358896411
         7178
         ----
         23463
         21534
         -----
          19294
          17945
          -----
          13491
          10767
          -----
          (2724)
```

The quot would run on to 49 figures of a finite part, and then a circle of 65 places; but limit it at feven places of decimals, and then complete it by a vulgar fraction; as follows, *viz.*

Complete the partial remainder 2724 by annexing to it the circle of the dividend, and placing both, by way of numerator, over the divifor 3589.

The numerator of this complex fraction being a mixt number, reduce it to an improper fraction, by multiplying 2724 by the denominator 99999, and adding the numerator 46341 to the product; as in the margin: and then, inftead of the mixt number, the numerator of the complex fraction will be $\frac{272443617}{99999}$. Or rather work thus: Efteem 2724.46341, a circulate; and then you find the numerator of the vulgar fraction by fubtracting the finite part.

```
272400000
     2724
---------
272397276
    46341
---------
272443617
```

```
358900000
     3589
---------
358896411
```

Next divide this fractional numerator by the denominator; which is done by multiplying 3589 by 99999, as in the margin; and now the simple vulgar fraction to be annexed to the partial quot is $\frac{272443617}{358896411}$.

If the quot thus completed be multiplied by the divisor, it will produce the dividend.

VII. *Decimal Practice.*

The price of goods or merchandise may be cast up decimally by any of the methods following.

Method I. Find the decimal of the rate, *viz.* the value of one yard, one pound, one piece, *&c.*; and this decimal of the rate multiplied into the number or quantity of the goods gives the price.

Ex. 1. At 3 s. 4 d. what cost 346?

The decimal of the rate is $.1\dot{6} = \frac{15}{90}$

```
   346
    15
   ----
  1730
  346
  ----              L.  s.  d.
5|0)519|0(57.6̇ = 57  13   4
    45
    --
     69
     63
     --
     60
     54
     --
     *6
```

Ex. 2. At 6 s. 8 d. what cost 439?

The decimal of the rate is $.\dot{3}$

```
                       L.  s.  d.
3)439(146.3̇ =  146   6   8
```

Meth. II. When the rate consists of pence and farthings, find how often it is contained in one pound Sterling, divide the given number of goods by this number, or by its component parts, or work by aliquot parts, and the result will be the price sought.

We confine this method to such rates as consist of pence and farthings, because when the rate consists of shillings, pence, and farthings, or of pounds, shillings, pence, *&c.* it is shorter and easier to work by Method I.

To make the practice ready and easy, it will be proper to have at hand a table of rates and divisors, such as the following one.

Table of Rates and Divisors.

Rates.	0 Farth.	1 Farth.	2 Farth.	3 Farth.
d.	Divis.	Divis.	Divis.	Divis.
0		3,8,40.	8,60.	8,40.
1	6,40.	8,6,4.	4,40.	4,30,—8.
2	4,30.	4,30,+8.	4,30,+4.	80,—12.
3	80.	80,+12.	80,+6.	80,+4.
4	60.	60,+4 of 4.	60+8.	60+8+2 of 8.
5	6,8.	40,—8.	40—12.	40—4 of 6.
6	40.	40+4 of 6.	40+12.	40+8.
7	40+6.	40+6+4 of 6.	40+4.	40+4+6 of 4.
8	30.	30+4 of 8.	30+2 of 8.	80,×3,—12 of 80.
9	80,×3.	80,×3,+12 of 80.	80,×3,+6 of 80.	80,×3,+4 of 80.
10	8,3.	30,+4,+8 of 4.	20,—8.	40,+2,+2,+6.
11	20,—12.	40,×2,—8 of 40.	40,×2,—12 of 40.	8,3,+5,—8 of .5

In the above table the pence stand in the left-hand column, and the farthings on the head, and the divisors in the angle of meeting; which are to be understood and read as follows.

3,8,40. Divide the given number of goods by 3, divide the quot by 8, and again divide this last quot by 40.

4,30,—8. Divide the number of goods by 4, divide the quot by 30, and from this last quot subtract one 8th of itself.

80+12. To an 80th add a 12th of that 80th.

4,30,+4. To a 30th of a 4th add a 4th of that 30th.

60,.

60,+4 of 4, Divide by 60, divide again the quot by 4, and to the first quot add a 4th of the second quot.

80×3,—12 of 80. Divide by 80, multiply the quot by 3, and from the product subtract a 12th of the first quot.

Ex. 1. At 1 f. *per* yard, what cost 432 yards?

One 3 d = 144
One 8th of that = 18
One 40th of that = .45 = 9 s.

Ex. 2. At 3 f. what cost 728.5?

One 8th = 91.0625 *L. s. d.*
One 40th of that = 2.2765625 = 2 5 6¼

METH. III. The third method is by decimal tables of rates suited to the nine digits; such as those composed and published by the Rev. Mr George Brown in 1718, under the title of *Arithmetica Infinita*, and recommended by Dr John Keill professor of astronomy in the university of Oxford.

These tables are still extant, and extend from 1 farthing to 20 s.; a short specimen of which, with their construction, and the manner of using them, we shall here subjoin.

Decimal Table of Rates, 1 l. the integer.

N.	Rate. s. d. 11 5	Rate. s. d. 11 5¼	Rate. s. d. 11 5½	Rate. s. d. 11 5¾
1	$0.5708\dot{3}$	0.571875	$0.57291\dot{6}$	$0.573958\dot{3}$
2	$1.141\dot{6}$	1.14375	$1.1458\dot{3}$	$1.14791\dot{6}$
3	1.7125	1.715625	1.71875	1.721875
4	$2.28\dot{3}$	2.2875	$2.291\dot{6}$	$2.2958\dot{3}$
5	$2.8541\dot{6}$	2.859375	$2.86458\dot{3}$	$2.869791\dot{6}$
6	3.425	3.43125	3.4375	3.44375
7	$3.9958\dot{3}$	4.003125	$4.01041\dot{6}$	$4.017708\dot{3}$
8	$4.5\dot{6}$	4.575	$4.58\dot{3}$	$4.591\dot{6}$
9	5.1375	5.146875	5.15625	5.165625

In the left-hand column stand the nine digits; and on the right of 1 are the decimals of the respective rates on the head. Thus, $.5708\dot{3}$ is the decimal of 11 s. 5 d. one pound being the integer; and .571875 is the decimal of 11 s. 5¼ d. *&c.* Those decimals opposite to 1 being multiplied through the nine digits, make up or compose the rest of the table.

The superior excellency of tables thus constructed is, that we multiply or divide by 10, 100, 1000, *&c.* by moving the decimal point so many places to the right or left as there are ciphers in the multiplier or divisor.

Hence the price or value of any number of yards, or other things, denoted by a single digit, or by any of its decuples, may be readily found. Thus, the price of 7, 70, 700, 7000, 70000, 700000 yards, at 11 s. 5 d. *per* yard, is found as follows.

Yards.	*L.*	*L.*	*s.*	*d.*
7 =	$3.9958\dot{3}$ =	3	19	11
70 =	$39.958\dot{3}$ =	39	19	2
700 =	$399.58\dot{3}$ =	399	11	8
7000 =	$3995.8\dot{3}$ =	3995	16	8
70000 =	$39958.\dot{3}$ =	39958	6	8
700000 =	$399583.\dot{3}$ =	399583	6	8

Now, every number may be resolved into decuples of the several digits of which it is composed; find therefore the price of each decuple by itself, as already taught, and their sum will be the price of the whole.

EXAMP. 1. Required the price of 7956 yards, at 11 s. 5¾ d. *per* yard.

Yards.	*L.*			
7000 =	$4017.708\dot{3}33$			
900 =	516.5625			
50 =	$28.69791\dot{6}$			
6 =	3.44375			
		L.	*s.*	*d.*
	4566.412500 =	4566	8	3

EXAMP. 2. How much money will one spend in a year, or 365 days, at the rate of 11 s. 5½ d. *per* day?

Days.	*L.*			
300 =	171.875			
60 =	34.375			
5 =	$2.86458\dot{3}$			
		L.	*s.*	*d.*
	$209.114583\dot{3}$ =	209	2	3½

Tables of this sort may be framed for a great variety of useful purposes, and are easily constructed.

Thus, suppose a table wanted for showing the daily income of any annuity, or yearly pension; in this case, divide 1 by 365, and the quot is the income of 1 l. annuity for one day; and by multiplying this quot through the nine digits, the table is constructed as follows.

TABLE.

1	0,02739726,
2	0,05479452,
3	0,08219178,
4	0,10958904,
5	0,13698630,
6	0,16438356,
7	0,19178082,
8	0,21917808,
9	0,24657534,

The use of the table will best appear by examples; which take as follows.

Example 1.

If one has a yearly pension of 375 l. what is his daily income?

	L.			
300 =	.8219			
70 =	.1917			
5 =	.0136			
		L.	*s.*	*d.*
	1.0272 =	1	0	6½

Example 2.

The yearly rent of a gentleman's estate is 968 l. 10 s. what can he afford to spend *per* day?

L. 900

			L.	s.	d.
900	=	2.4657			
60	=	.1643			
8	=	.0219			
0.5	=	.0013			
		2.6532	= 2	13	$0\frac{1}{2}$

If the income for any number of days be required, find the income for one day as above; and multiply the decimal anſwer by the given number of days. Or, multiply the yearly penſion by the given number of days, and uſe the product as the yearly penſion. Thus, in Ex. 2. if the gentleman's income for 64 days be demanded, you may either multiply 2.6532 by 64; or multiply 968.5 by 64; and then work for the product as follows.

					L.	s.	d.
968.5		60000	=	164.3835			
64		1000	=	2.7397			
		900	=	2.4657			
38740		80	=	.2191			
58110		4	=	.0109			
61984.0				169.8189	= 169	16	$4\frac{1}{2}$

The decimals in the table being circles of eight figures, we have uſed them as approximates, by confining the operations to four decimal places; which, in affairs of this kind, is ſufficiently accurate.

If the annual intereſt of any principal ſum be conſidered as the yearly penſion, the intereſt of the ſame principal for any number of days may be found by the table as taught above.

The intereſt of any principal ſum for a year is eaſily found, as being always the hundredth part of the product of the principal multiplied by the rate *per cent*.

Examp. Required the intereſt for 26 days of 685 l. principal, at 5 *per cent.*

					L.	s.	d.
L.							
685							
5							
34.25 annual intereſt.							
26							
		800	=	2.19178			
20550		90	=	.24657			
6850		0.5	=	.00136			
890.50				2.43971	= 2	8	$9\frac{1}{2}$

DUODECIMALS.

Decimal practice may be uſed with great advantage in the multiplication and diviſion of duodecimals, where the integer is divided into twelve equal parts, called *primes*, and each prime into twelve ſeconds, each ſecond into twelve thirds, *&c.*

For the ready converſion of primes, ſeconds, thirds, *&c.* into decimals of the integer, the following table is conſtructed.

Decimal table of primes, ſeconds, &c.

N.	Primes. ′	Seconds. ″	Thirds. ‴	Fourths. ⁗
1	.08$\dot{3}$	.0069$\dot{4}$	.000578,703,	.00004822
2	.1$\dot{6}$	.013$\dot{8}$	.001157,407,	.00009645
3	.25	.0208$\dot{3}$	.001736,111,	.00014467
4	.$\dot{3}$	.02$\dot{7}$	.002314,814,	.00019290
5	.41$\dot{6}$	.0347$\dot{2}$	.002893,518,	.00024112
6	.5	.041$\dot{6}$	.003472,222,	.00028935
7	.58$\dot{3}$	.0486$\dot{1}$	.004050,925,	.00033757
8	.$\dot{6}$	.0$\dot{5}$	.004629,629,	.00038580
9	.75	.0625	.005208,333,	.00043402
10	.8$\dot{3}$	.069$\dot{4}$	.005787,037,	.00048215
11	.91$\dot{6}$	.0763$\dot{8}$	.006365,740,	.00053047

In the column of fourths, the decimals run on to eight places of a finite part, and nine figures of a circle; but the finite part by itſelf, which alone is inſerted in the table, will be found ſufficient; and in the column of thirds too, the circle of three figures may in moſt caſes be neglected.

I. *Multiplication.*

Example 1.

What is the product of 24 7′ by 18 5′.

24 7′ = 24.58$\dot{3}$
18 5′ = 18.41$\dot{6}$ = $\frac{16575}{900}$

	Or thus:
24.58$\dot{3}$	24.58333
16575	614.81
12291$\dot{6}$	2458333
172083$\dot{3}$	1966666
12291$\dot{6}$66	98333
147500000	2458
245833333	
	452.5790
9|00) 407468.750	$\frac{2}{3}$ = 819
	$\frac{2}{3}$ = 819
452.7430$\dot{5}$	
12	452.7428
	12
8.91$\dot{6}$66	
12	8.9136
	12
11.000	
	10.9632

Anſ. 452 8′ 11″

In working by the inverted method, for the repeating 6 in the multiplier, take $\frac{2}{3}$ of the multiplicand. The refult wants very little of the true anfwer.

Examp. 2.

Multiply 18′ 6 by 2′ 4, and 2′ 3 continually.

```
18′ 6=18.5          2.3
 2  4= 2.3          18.5
 2  3=2.25         -----
                     116
                    1866
                    2333
                   -----
                   43.16
                    2.25
                   -----
                   21583
                   86333
                  863333
                  -------
                 97.1250
                      12     Anſ. 97′ 1″ 6
                 -------
                   1.500
                   12
                   -----
                   6.0
```

II. *Divifion.*

Examp. 1.

```
Divide 452′  8″  11 = 452.74308
    by  18   5      = 18.416 = ,6575/900

18.416)4527.43085
  1841  452.74308
------ ----------
16575)407468.750(24.583
      33150·  ··        12
      -----         -----
       75968        7.000
       66300
       -----
        96687
        82875              Anſ. 24′ 7
        -----
        138125
        132600
        ------
          55250
          49725
          -----
          *5525
```

Examp. 2.

```
Divide 97′ 1″ 6=97.125
    by  2  3    = 2.25   and the quot
    by 18  6    =18.5
               18.5)
2.25)97.125(43.16(2.3
     900 ··  370    12
     ---     ---   ---
     712     616   4.0
     675     555
     ---     ---
      375    *61
      225
      ---
      1500
      1350    Anſ. 2′ 4
      ----
      *150
```

SEXAGESIMALS.

Decimal practice might likewife be ufed to good purpofe in the arithmetic of fexagefimals, as it would fhorten and facilitate the operations.

Sexagefimals, ftrictly fpeaking, are degrees, minutes, feconds, thirds, &c. where each degree is divided into 60 minutes, and each minute into 60 feconds, &c.; but under this title is alfo ufually comprehended the divifion of a fign into 30 degrees. They are commonly marked as under.

Signs.	*deg.* °	*min.* ′	*fec.* ″	*thirds.* ‴	
7	24	36	54	48	&c.

Sexagefimals properly belong to aftronomy, being ufed in computations of motion and time, where the degree of motion, and hour of time, are equally divided into 60 minutes. The preference of the decimal method to that of the fexagefimal will appear from the following example of addition done both ways.

Sexagefimally. *Signs.*	°	′	″		*Decimally.* S.
10	20	47	17	=	10.69293,518,
7	18	50	40	=	7.62814,814,
9	25	30	28	=	9.85018,518,
11	10	40	50	=	11.35601,851,
3	15	49	7	=	3.52728,703,

From the above example it is obvious, that even in addition the decimal operation is more fimple and eafy than the fexagefimal, efpecially if care be taken to ufe no more decimal places than what are abfolutely neceffary.

But in multiplication and divifion the advantage of the decimal method is ftill greater; for in the fexagefimal way the operation is extremely tedious; whereas, by working decimally, it is performed in the fame manner, and with the fame eafe, as in duodecimals.

VULGAR FRACTIONS.

Decimal practice may fometimes be profitably ufed in the

the arithmetic of vulgar fractions, the operation being ſhorter and eaſier in the decimal than in the vulgar way. This we ſhall illuſtrate by a few examples.

I. *Addition.*

Ex. 1. What is the ſum of $\frac{1}{4}+\frac{2}{3}$ l.?

$\frac{1}{4}=.25$
$\frac{2}{3}=.\dot{6}66$

$.91\dot{6}=18$ s. 4 d.

Ex. 2. What is the ſum of $14\frac{7}{8}+18\frac{2}{3}+\frac{3}{4}$ of $\frac{5}{6}$ C.?

C.
$14\frac{7}{8}=14.875$
$18\frac{2}{3}=18.\dot{6}666$
$\frac{3}{4}$ of $\frac{5}{6}=\frac{5}{8}=.625$

$34.1\dot{6}66=34$ C. 0 Q. $18\frac{2}{3}$ lb.

II. *Subtraction.*

Ex. 1. From $\frac{3}{4}$ ſubtract $\frac{1}{3}$ l.

L.
$\frac{3}{4}=.75$
$\frac{1}{3}=.\dot{3}33$

$.41\dot{6}=8$ s. 4 d.

Ex. 2. From $\frac{2}{3}$ of $\frac{7}{8}$ ſubtract $\frac{1}{2}$ of $\frac{1}{4}$ ℔. Troy.

lb.
$\frac{2}{3}$ of $\frac{7}{8}=\frac{7}{12}=.58\dot{3}3$
$\frac{1}{2}$ of $\frac{1}{4}=\frac{1}{8}=.125$

$.458\dot{3}=5$ oz. 10 dw.

III. *Multiplication.*

Ex. Multiply $19\frac{7}{12}$ by $22\frac{1}{3}$ feet.

F.
$19\frac{7}{12}$ - - - - $=19.58\dot{3}$
$22\frac{1}{3}=22.\dot{3}=\frac{201}{9}$ $\quad 201$

$1958\dot{3}$
$3916\dot{6}66$

$9)3936.250$

$437.36\dot{1}=437$ Sq. f. 52 ſq. in.

II. *Diviſion.*

Ex. Divide $6\frac{7}{18}$ by $\frac{4}{11}$.

$\frac{4}{11}=.36$, and $6\frac{7}{18}=6.3\dot{8}$

$.36,)638.\dot{8}8($
$00 \quad 6.3\dot{8}$

$36)632.50(17.5694=17$ L. 11 s. $4\frac{2}{5}$ d.
36

272
252

205
180

250
216

340
324

160
144

$*16$

Rule of Three Direct.

Decimal practice is frequently the ſhorteſt and eaſieſt method of operation in the rule of three.

Examp. I. If C. 3 : 1 : 14 of raiſins coſt L. 10 : 2 : 6, what will 6. C. 3 Q. coſt at that rate?

	C. Q. lb.	L. s. d.	C. Q.
Vulgar ſtate	3 1 14 :	10 2 6 ::	6 3
Decimal ſtate	3.375 :	10.125 ::	6.75

10.125
6.75

50625
70875
60750

$3.375)68.34375(20.25=20$ L. 5 s.
6750

8437
6750

16875
16875

Examp. II. If a wedge of gold, weighing 14 ℔. 3 oz. 8 dw. coſt L. 514, 4 s. what is that *per* ounce?

Vulgar

```
              lb. oz. dw.  L.  s.   oz.
Vulgar ſtate   14  3  8 : 514  4 ::  1
Decimal ſtate  14.283   : 514.2  :: .083
                                     514.2
                                     -----
                                       166
                                      1333
                                      8333
                                    416666
                                    ------
                      14.283)42.8500(
                        1428  42.850
                      ------  ------ L.
                      12855)38565-0(3 Anſ.
                            38565
```

Rule of Three Inverſe.

Examp. If you borrow L. 64 for 8 months, what ſum lent for 12 months, or a year, will requite the favour?

```
              Y.   L.   Y.
Vulgar ſtate   1 : 64 :: 8/12
Decimal ſtate  1 : 64 :: 6
                      6
                     ---     L.   s.  d.
               9)384(42.6=42  13   4
                 36
                 --
                 24
                 18          Or thus :
                 --
                 60         3)64(21.3
                 54              21.3
                 --              ----
                 *6  The ſame 42.6 as before.
```

Compound Rule of Three.

Examp. What is the intereſt of L. 75 : 10 : 4 for 8 months, at the rate of 5 *per cent. per annum?*

```
               M.    L.   L.  L.  s.  d.  M.
Vulgar ſtate   12 × 100 : 5 :: 75  10  4 × 8
Decimal ſtate  12 × 100 : 5 :: 75.516 × 8
                     12              8
                   ----      -------
                   1200 : 5 :: 604.133
                                     5
                              --------
                     12|00) 3020.066(
                            --------  L.  s.  d.
                             2.5172 = 2   10   4
```

The ſimple ſeparate operations of the ſame example follow.

```
 L.  L.   L.                   M.  L.         M.
100 : 5 :: 75.516              12 : 3.77583 : : 8
               5                           8
         -------                   ----------
   1|00)377.583(                   12)30.20666(
        -------                       ---------
        3.77583                        2.5172 Anſ.
```

Chap. XII. Extraction of Roots.

If unity be multiplied continually by any given number, the products thence ariſing are called *powers of that number*; and the given number is called *the root*, or *firſt power*.

Thus, if 2 be the given number, then $1\times2=2$ is the root or firſt power; and $2\times2=4$ is the ſquare or ſecond power; and $4\times2=8$ is the cube or third power; and $8\times2=16$ is the biquadrate or fourth power; and $16\times2=32$ is the ſurſolid or fifth power; and $32\times2=64$ is the ſixth power, or cube ſquared, &c.

The natural numbers, 1, 2, 3, &c. are ſometimes placed over theſe powers, denoting the number of multiplications uſed in producing them, or ſhowing what powers they are; and are called *indices* or *exponents*, as in the following ſcheme.

Indices, 0, 1, 2, 3, 4, 5, 6, 7, &c.
Powers, 1, 2, 4, 8, 16, 32, 64, 128, &c.

The raiſing any root or number given to any power required, is called *involution*; and is performed by multiplying the given root into unity continually, as taught above. But the finding the root of a given power is called *evolution*, or *extraction of roots*.

If the root of any power not exceeding the ſeventh power, be a ſingle digit, it may be obtained by inſpection, from the following table of powers.

T A B L E.

1ſt power or root.	2d power or ſquare.	3d power or cube.	4th power or biquadrate	5th power or ſurſolid.	6th power or cube ſquared.	7th power.
1	1	1	1	1	1	1
2	4	8	16	32	64	128
3	9	27	81	243	729	2187
4	16	64	256	1024	4096	16384
5	25	125	625	3125	15625	78125
6	36	216	1296	7776	46656	279936
7	49	343	2401	16807	117649	823543
8	64	512	4096	32768	262144	2097152
9	81	729	6561	59049	531441	4782969

I. *Extraction of the Square Root.*

Rule I. Divide the given number into periods of two figures, beginning at the right hand in integers, and pointing toward the left. But in decimals, begin at the place of hundreds, and point toward the right. Every period will give one figure in the root.

II. Find by the table of powers, or by trial, the neareſt leſſer root of the left-hand period, place the figure ſo found in the quot, ſubtract its ſquare from the ſaid period, and to the remainder bring down the next period for a dividual or reſolvend.

III. Double the quot for the firſt part of the diviſor; inquire how often this firſt part is contained in the whole reſolvend, excluding the units place; and place the figure denoting the anſwer both in the quot and on the

the right of the first part; and you have the divisor complete.

IV. Multiply the divisor thus compleated by the figure put in the quot, subtract the product from the resolvend, and to the remainder bring down the following period for a new resolvend, and then proceed as before.

Note 1. If the first part of the divisor, with unity supposed to be annexed to it, happen to be greater than the resolvend, in this case place o in the quot, and also on the right of the partial divisor; to the resolvend bring down another period; and proceed to divide as before.

Note 2. If the product of the quotient-figure into the divisor happen to be greater than the resolvend, you must go back, and give a lesser figure to the quot.

Note 3. If, after every period of the given number is brought down, there happen at last to be a remainder, you may continue the operation, by annexing periods or pairs of ciphers, till there be no remainder, or till the decimal part of the quot repeat or circulate, or till you think proper to limit it.

EXAMP. I. Required the square root of 133225.

```
Square number 133225(365 root          365
              9                        365
              ------                   -----
   1 div. 66) 432 resolvend.           1825
              396 product.            2190
              ----                    1095
  2 div. 725) 3625 resolvend.         ------
              3625 product.          133225 proof.
```

EXAMP. II. Required the square root of 72, to eight decimal places.

```
   72.00000000(8.48528137 root.
   64
   ---
164) 800
     656
     ----
1688)14400
     13504
     -----
16965)89600
      84825
      -----
169702)477500
       339404
       ------
169704)138096
       135763
       ------
         2333
         1697
         ----
          636
          509
          ---
          127
          118
          ---
          (9)
```

After getting half of the decimal places, work by contracted division for the other half; and obtain them with the same accuracy as if the work had been at large.

EXAMP. III. Required the square root of .2916.

```
     .2916(.54 root.
      25
      ---
104)  416
      416
      ---
```

If the square root of a vulgar fraction be required, find the root of the given numerator for a new numerator, and find the root of the given denominator for a new denominator. Thus, the square root of $\frac{4}{9}$ is $\frac{2}{3}$, and the root of $\frac{16}{49}$ is $\frac{4}{7}$; and thus the root of $\frac{25}{4}$ $(=6\frac{1}{4})$ is $\frac{5}{2}=2\frac{1}{2}$.

But if the root of either the numerator or denominator cannot be extracted without a remainder, reduce the vulgar fraction to a decimal, and then extract the root, as in Example III. above.

II. *Extraction of the Cube Root.*

RULE I. Divide the given number into periods of three figures, beginning at the right hand in integers, and pointing toward the left. But in decimals, begin at the place of thousands, and point toward the right. The number of periods shews the number of figures in the root.

II. Find by the table of powers, or by trial, the nearest lesser root of the left-hand period; place the figure so found in the quot; subtract its cube from the said period; and to the remainder bring down the next period for a dividual or resolvend.

The divisor consists of three parts which may be found as follows.

III. The first part of the divisor is found thus: Multiply the square of the quot by 3, and to the product annex two ciphers; then inquire how often this first part of the divisor is contained in the resolvend, and place the figure denoting the answer in the quot.

IV. Multiply the former quot by 3, and the product by the figure now put in the quot; to this last product annex a cipher; and you have the second part of the divisor. Again, square the figure now put in the quot for the third part of the divisor; place these three parts under one another, as in addition; and their sum will be the divisor complete.

V. Multiply the divisor, thus completed, by the figure last put in the quot, subtract the product from the resolvend, and to the remainder bring down the following period for a new resolvend, and then proceed as before.

Note 1. If the first part of the divisor happen to be equal to or greater than the resolvend, in this case place o in the quot, annex two ciphers to the said first part of the divisor, to the resolvend bring down another period, and proceed to divide as before.

Note 2. If the product of the quotient-figure into the divisor happen to be greater than the resolvend, you must go back, and give a lesser figure to the quot.

Note 3. If, after every period of the given number is brought down, there happen at last to be a remainder, you may continue the operation by annexing periods of three ciphers till there be no remainder, or till you have

as many decimal places in the root as you judge neceſſary.

EXAMP. I. Required the cube root of 12812904.

Cube number 12812904(234 root
8

1ſt part 1200)4812 reſolvend,
2d part 180
3d part 9

1 diviſor $1389 \times 3 = 4167$ product.

1ſt part 158700)645904 reſolvend.
2d part 2760
3d part 16

2 diviſor $161476 \times 4 = 645904$ product.

P R O O F.

234	Square 54756
234	234
936	219024
702	164268
468	109512
Square 54756	Cube 12812904

EXAMP. II. Required the cube root of $28\frac{3}{4}$.

28.750000(3.06 root.
27

270000) 1750000 reſolv.
5400
36

Div. $275436 \times 6 = 1652616$ prod.

97384 rem.

P R O O F.

3.06	Sq. 9.3636
3.06	3.06
1836	561816
918	280908
Sq. 9.3636	28.652616
	97384 rem.
	28.750000 cube.

If the cube root of a vulgar fraction be required, find the cube root of the given numerator for a new numerator, and the cube root of the given denominator for a new denominator. Thus, the cube root of $\frac{8}{27}$ is $\frac{2}{3}$, and the cube root of $\frac{27}{64}$ is $\frac{3}{4}$; and thus the cube root of $\frac{125}{8}$ $(=15\frac{5}{8})$ is $\frac{5}{2}=2\frac{1}{2}$.

But if the root of either the numerator or denominator cannot be extracted without a remainder, reduce the vulgar fraction to a decimal, and then extract the root.

III. *Extraction of the Biquadrate Root.*

RULE. Extract the ſquare root of the given number; and again extract the ſquare root of the root ſo found, and the laſt of theſe roots is the root ſought.

EXAMP. Required the biquadrate root of 5308416.

5308416 (2304(48 root.
4 16

43)130 88)704
129 704

4604) 18416
18416

If, in the firſt extraction, there happen to be a remainder, continue the operation, by annexing pairs of ciphers, till you have twice as many decimal places in the ſquare or firſt root, as you propoſe to have in the laſt root.

IV. *Extraction of the root of the fifth power, or ſurſolid.*

RULE I. Divide the given number into periods of five figures, find the neareſt leſſer root of the left-hand period, put the figure ſo found in the quot, ſubtract its fifth power, and to the remainder bring down the next period for a reſolvend.

II. Put $a+y$ for the root, and then the ſurſolid or fifth power will be $aaaaa + 5aaaay + 10aaayy + 10aayyy + 5ayyyy + yyyyy$. Now, $aaaaa$ being already ſubtracted, there remains the other five parts; and to find y, divide by its coefficient, *viz.* by $5aaaa+10aaay+10aayy + 5ayyy + yyyy$; that is, try how often $5aaaa$ is contained in the reſolvend; and, by the help of the quotient-figure, you make up the other four parts of the diviſor.

EXAMP. Required the ſurſolid root of 33554432

33554432(32 root.
243

) 9254432 reſolv.
$4050000 = 5aaaa$
$540000 = 10aaay$
$36000 = 10aayy$
$1200 = 5ayyy$
$16 = yyyy$

Diviſor $4627216 \times 2 = 9254432$ prod.

(o)

V. *Extraction of the root of the ſixth power, or cube ſquared.*

RULE. Extract the ſquare root of the given number, and then extract the cube root of that root, the laſt is the

the root ſought. Or, firſt extract the cube root, and then extract the ſquare root of that root.

Examp. Required the root of 191102976, being the ſixth power.

```
191102976  (13824(24 root.
1           8
———         ———
23) 91     1200)5824 reſolv.
    69      240
    ———      16
268)2210    ———
    2144    1456 × 4 = 5824 prod.
    ———                ———
2762) 6629             (0)
      5524
      ———
27644)110576
      110576
      ———
```

VI. *Extraction of the root of the ſeventh power.*

Rule. Put $a+y$ for the root, and the ſeventh power will be $aaaaaaa + 7aaaaaay + 21aaaaayy + 35aaaayyy + 35aaayyyy + 21aayyyyy + 7ayyyyyy + yyyyyyy$, by the aid of which proceed as in extracting the root of the fifth power.

Examp. Required the root of 3404825447, being the ſeventh power.

```
                3404825447(23 root.
                128
                ———
                )2124825447 reſolv.
                ———
448000000  =  7aaaaaa
201600000  =  21aaaaay
 50400000  =  35aaaayy
  7560000  =  35aaayyy
   680400  =  21aayyyy
    34020  =  7ayyyyy
      729  =  yyyyyy
———————————
Diviſ. 708275149 × 3 = 2124825447 prod.
                       ———
                       (0)
```

VII. *Extraction of the root of the eighth power.*

Rule. Extract the ſquare root of the given number continually till you have three roots; the laſt of theſe is the root ſought.

Thus, let 1785793904896 be the eighth power; by extracting the ſquare root you get the biquadrate or fourth power, *viz.* 1336336; and by extracting the ſquare root of the biquadrate, you get the ſquare or ſecond power, *viz.* 1156, whoſe ſquare root is 34, the root ſought.

VIII. *Extraction of the root of the ninth power.*

Rule. Extract the cube root of the given number, and you have the cube or third power, whoſe cube root is the root ſought.

Thus, let 5159780352 by the ninth power; by extracting the cube root you get the cube or third power, *viz.* 1728, whoſe cube root 12 is the root ſought.

Univerſally, whatever the given power be, put $a+y$ for the root, and by involution raiſe $a+y$ to the power of the given number; then, with this as your guide or canon, extract the root in the manner preſcribed and exemplified in the extraction of the root of the fifth and ſeventh powers.

But if the index of the given power be a multiple of 2, the work may be rendered eaſier: For, by extracting the ſquare root of the given number, you obtain a power whoſe index is one half of the index of the given power. Thus, by extracting the ſquare root of the tenth power, you have the fifth power; and the ſquare root of the twelth power is the ſixth power, &c.

Again, if the index of the given power be a multiple of 3, by extracting the cube root you obtain a power whoſe index is one third of the index of the power given. Thus the cube root of the ninth power is the cube or third power; and the cube root of the twelfth power is the biquadrate or fourth power, &c.

Involution is directly contrary to extraction or evolution; and therefore, if a ſquare number be ſquared, it will give the biquadrate or fourth power; and if a biquadrate be ſquared, it will give the eighth power. Again, if a cube number be cubed, it will give the ninth power; and if the biquadrate be cubed, it will give the twelfth power. See Algebra, Chap. IX. and X.

For the application of Arithmetic to various branches of buſineſs, &c. ſee Alligation, Annuities, Barter, Brokage, Bankruptcy, Exchange, Insurance, Interest, Mensuration, &c. &c.

ARITHMOMANCY, a ſpecies of divination performed by means of numbers.

ARK, or *Noah's* Ark, a floating veſſel built by Noah, for the preſervation of his family, and the ſeveral ſpecies of animals, during the deluge. See Plate XXXVIII. fig. 1.

The ark has afforded ſeveral points of curious inquiry among the critics and naturaliſts, relating to its form, capacity, materials, &c.

The wood whereof the ark was built, is called in the Hebrew *Gopher-wood*, and in the Septuagint *ſquare timbers*. Some tranſlate the original *cedar*, others *pine*, others

others *box*, &c. Pelletier prefers cedar, on account of its incorruptibility, and the great plenty of it in Asia; whence Herodotus and Theophrastus relate, that the kings of Egypt and Syria built whole fleets thereof, instead of deal.

The learned Mr Fuller in his Miscellanies, has observed, that the wood whereof the ark was built, was nothing else but that which the Greek call *κυπαρισσος*, or the *cypress-tree*; for, taking away the termination, *kupar* and *gopher* differ very little in sound. This observation the great Bochart has confirmed, and shewn very plainly that no country abounds so much with this wood as that part of Assyria which lies about Babylon.

In what place Noah built and finished his ark is no less made a matter of disputation. But the most probable opinion is, that it was built in Chaldæa, in the territories of Babylon, where there was so great a quantity of cypress in the groves and gardens in Alexander's time, that that prince built a whole fleet out of it, for want of timber. And this conjecture is confirmed by the Chaldean tradition, which makes Xithurus (another name for Noah) set sail from that country.

The dimensions of the ark, as given by Moses, are 300 cubits in length, 50 in breadth, and 30 in height, which some have thought too scanty, considering the number of things it was to contain; and hence an argument has been drawn against the authority of the relation. To solve this difficulty many of the ancient fathers, and the modern critics, have been put to very miserable shifts: But Buteo and Kircher have proved geometrically, that, taking the common cubit of a foot and a half, the ark was abundantly sufficient for all the animals supposed to be lodged in it. Snellius computes the ark to have been above half an acre in area, and father Lamy shews, that it was 110 feet longer than the church of St Mary at Paris, and 64 feet narrower; and if so, it must have been longer than St Paul's church in London, from west to east; and broader than that church is high in the inside, and 54 feet of our measure in height; and Dr Arbuthnot computes it to have been 81062 tuns.

The things contained in it were, besides eight persons of Noah's family, one pair of every species of unclean animals, and seven pair of every species of clean animals, with provisions for them all during the whole year. The former appears, at first view, almost infinite; but if we come to a calculation, the number of species of animals will be found much less than is generally imagined, not amounting to an hundred species of quadrupeds, nor to two hundred of birds; out of which, in this case, are excepted such animals as can live in the water. Zoologists usually reckon but an hundred and seventy species in all; and bishop Wilkins shews that only seventy-two of the q uadruped kind needed a place in the ark.

By the description Moses gives of the ark, it appears to have been divided into three stories, each ten cubits, or fifteen feet high; and it is agreed on, as most probable, that the lowest story was for the beasts, the middle for the food, and the upper for the birds, with Noah and his family; each story being subdivided into different apartments, stalls, *&c.* Though Josephus, Philo, and other commentators, add a kind of fourth story under all the rest; being, as it were, the hold of the vessel, to contain the ballast, and receive the filth and fæces of so many animals: But F. Calmet thinks, that what is here reckoned a story, was no more than what is called the *keel* of ships, and served only for a conservatory of fresh water. Drexelius makes three hundred apartments. F. Fournier, three hundred and thirty-three; the anonymous author of the Questions on Genesis, four hundred; Buteo, Temporarius, Arias Montanus, Hostus, Wilkins, Lamy, and others, suppose as many partitions as there were different sorts of animals. Pelletier makes only seventy-two, *viz.* thirty-six for the birds, and as many for the beasts; his reason is, that if we suppose a greater number, as 333, or 400, each of the eight persons in the ark must have had thirty-seven, forty-one, or fifty stalls to attend and cleanse daily, which he thinks impossible to have been done. But it is observed, that there is not much in this; to diminish the number of stalls without a diminution of animals is vain; it being perhaps more difficult to take care of three hundred animals in seventy-two stalls, than in three hundred. As to the number of animals contained in the ark, Buteo computes that it could not be equal to five hundred horses; he even reduces the whole to the dimensions of fifty-six pair of oxen. F. Lamy enlarges it to sixty-four pair of oxen, or an hundred and twenty-eight oxen; so that supposing one ox equal to two horses, if the ark had room for two hundred and fifty-six horses, there must have been room for all the animals. But the same author demonstrates, that one floor of it would suffice for five hundred horses, allowing nine square feet to a horse.

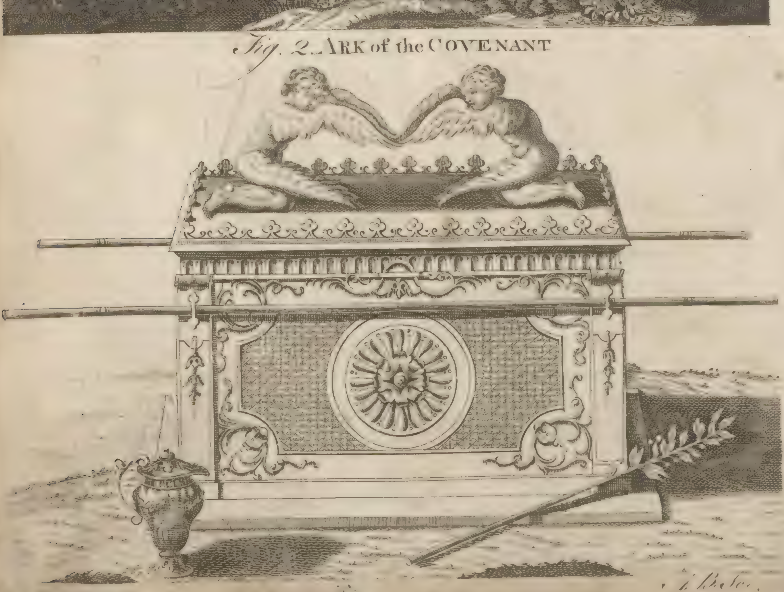
As to the food in the second story, it is observed by Buteo from Columella, that thirty or forty pounds of hay ordinarily suffices for an ox a day, and that a solid cubit of hay, as usually pressed down in our hayricks, weighs about forty pounds; so that a square cubit of hay is more than enough for one ox in one day. Now it appears that the second story contained 150,000 solid cubits, which divided between two hundred and six oxen, will afford each more hay by two thirds, than he can eat in a year. Bishop Wilkins computes all the carnivorous animals, equivalent, as to the bulk of their bodies, and their food, to twenty-seven wolves; and all the rest to two hundred and eighty beeves. For the former he allows 1825 sheep, and for the latter, 109,500 cubits of hay, all which will be easily contained in the two first stories, and a deal of room to spare. As to the third story, no body doubts of its being sufficient for the fowls; with Noah, his sons, and daughters. Upon the whole, the learned bishop remarks, that of the two, it appears much more difficult to assign a number and bulk of necessary things to answer the capacity of the ark, than to find sufficient room for the several species of animals already known to have been there. This he attributes to the imperfection of our list of animals, e-

specially

Plate XXXVIII.

Fig. 1. NOAH'S ARK *floating on the waters of the Deluge*

Fig. 2. ARK of the COVENANT



ſpecially thoſe of the unknown parts of the earth; adding, that the moſt expert mathematician at this day could not aſſign the proportion of a veſſel better accommodated to the purpoſe than is here done; and hence finally concludes, that the capacity of the ark, which had been make an objection againſt ſcripture, ought to be eſteemed a confirmation of its divine authority, ſince, in thoſe ruder ages, men, being leſs verſed in arts and philoſophy, were more obnoxious to vulgar prejudices than now; ſo that had it been an human invention, it would have been contrived, according to thoſe wild apprehenſions which ariſe from a confuſed and general view of things, as much too big, as it had been repreſented too little.

But it muſt be obſerved, that beſides the places requiſite for the beaſts and birds, and their proviſions, there was room required for Noah to lock up houſehold utenſils, the inſtruments of huſbandry, grains and ſeeds, to ſow the earth with after the deluge; for which purpoſe it is thought that he might ſpare room in the third ſtory for ſix and thirty cabbins, beſides a kitchen, a hall, four chambers, and a ſpace about eight and forty cubits in length to walk in.

Ark *of the covenant*, a ſmall cheſt or coffer, three feet nine inches in length, two feet three inches in breadth, and two feet three inches in height, in which were contained the golden pot that had manna, and Aaron's rod, and the tables of the covenant. This coffer was made of ſhittim-wood, and was covered with the mercy-ſeat, which was of ſolid gold; at the two ends whereof were two cherubims, looking toward each other, with expanded wings, which, embracing the whole circumference of the mercy-ſeat, met on each ſide in the middle. The whole, according to the rabbins, was made out of the ſame maſs, without joining any of the parts by ſolder. Here it was that the Schechinah or Divine Preſence reſted, both in the tabernacle and in the temple, and was viſibly ſeen in the appearance of a cloud over it; and from hence the Divine oracles were given out by an audible voice, as often as God was conſulted in the behalf of his people. Plate XXXVIII. fig. 2.

ARKLOW, a ſea-port town of Ireland, ſituated in the county of Wicklow, about thirteen miles ſouth of the city of Wicklow, in 6° 20′ W. long. and 52° 55′ N. lat.

ARLES, a city of Provence in France, ſituated on the eaſtern ſhore of the river Rhone, in 4° 45′ E. long. and 43° 32′ N. lat.

ARLEUX, a town of Hainault, in the French Netherlands, ſituated about ſix miles ſouth of Douay, in 3° E. long. and 50° 20′ N. lat.

ARLON, a town of the duchy of Luxemburg, on the Auſtrian Netherlands, ſituated in 5° 30′ E. long. and 49° 45′ N. lat.

ARM, in riding, is applied to a horſe, when, by preſſing down his head, he endeavours to defend himſelf againſt the bit, to prevent obeying, or being checked thereby.

ARMADA, a Spaniſh term, ſignifying a fleet of men of war, as *armadilla* ſignifies a ſquadron.

ARMADABAT, a very large city of Aſia, the metropolis of the kingdom of Guzarat.

ARMADILLO, in zoology, a ſynonime of the daſypus. See Dasypus.

ARMAGH, once a conſiderable city of Ireland, but now much reduced, ſituated about thirty miles ſouth of Londonderry, in 6° 45′ W. long and 54° 30′ N. lat. It is ſtill the ſee of the primate of Ireland, and gives name to the county of Armagh.

ARMAGNAC, a diſtrict or territory in the north-eaſt part of Gaſcony in France.

ARMAN, in farriery. See Drench.

ARMED, in the ſea-language. A croſs-bar ſhot, is ſaid to be armed, when ſome rope-yarn or the like is rolled about the end of the iron bar, which runneth through the ſhot.

Armed, in heraldry, is uſed when the horns, feet, beak, or talons of any beaſt or bird of prey, are of a different colour from the reſt of their body.

ARMENIA, a large country of Aſia, comprehending Turcomania and part of Perſia.

ARMENIACA, in botany. See Prunus.

ARMENIANS, in church-hiſtory, a ſect among the eaſtern Chriſtians; thus called from Armenia, the country anciently inhabited by them. There are two kinds of Armenians, the one catholic and ſubject to the pope, having a patriarch in Perſia, and another in Poland; the other makes a peculiar ſect, having two patriarchs in Natolia. They are generally accuſed of being manophyſites, only allowing of one nature in Jeſus Chriſt. As to the euchariſt, they for the moſt part agree with the Greeks; they abſtain rigorouſly from eating of blood and meats ſtrangled, and are much addicted to faſting.

ARMENTIERS, a fortified town in French Flanders, ſituated about ſeven miles weſt of Liſle, in 2° 50′ E. long. and 50° 42′ N. lat.

ARMIERS, a town of Hainault, in the French Netherlands, ſituated on the river Sambre, about twenty miles ſouth of Mons, in 3° 40′ E. long and 50° 15′ N. lat.

ARMIGER, an eſquire, or armour-bearer. See Esquire.

ARMILLARY, in a general ſenſe, ſomething conſiſting of rings, or circles.

ARMILLARY *ſphere*, an artificial ſphere, compoſed of a number of circles, repreſenting the ſeveral circles of the mundane ſphere, put together in their natural order; to eaſe and aſſiſt the imagination, in conceiving the conſtitution of the heavens, and the motions of the celeſtial bodies. See Geography.

ARMILUSTRIUM, in Roman antiquity, a feaſt held among the Romans, in which they ſacrificed armed, to the ſound of trumpets

ARMINGS, in the ſea-language. See Armed.

ARMINIANS, in church-hiſtory, a ſect of Chriſtians which aroſe in Holland, by a ſeparation from the Calviniſts. They are great aſſertors of free-will. They ſpeak very ambiguouſly of the preſence of God. They look upon the doctrine of the Trinity as a point not neceſſary to ſalvation; and many of them hold there is no precept in ſcripture by which we are enjoined to

to adore the Holy Ghoſt; and that Jeſus is not equal to God the Father.

ARMIRO, a town of European Turky, in the province of Theſſaly, ſituated in 23° 30′ E. long.

ARMOISIN, a ſilk ſtuff, or kind of taffety, manufactured in the E. Indies, at Lyons in France, and Lucca in Italy. That of the Indies is ſlighter than thoſe made in Europe.

ARMONIAC, or AMMONIAC, a volatile ſalt, of which there are two kinds, ancient and modern. The ancient ſort, deſcribed by Pliny and Dioſcorides, was a native ſalt, generated in thoſe large inns or caravanſeras, where the croud of pilgrims, coming from the temple of Jupiter Ammon, uſed to lodge; who, in thoſe parts, traveling upon camels, and thoſe creatures when in Cyrene, a province of Egypt, where that celebrated temple ſtood, urining in the ſtables, or, ſay ſome, in the parched ſands, out of this urine, which is remarkably ſtrong, aroſe a kind of ſalt, denominated ſometimes, from the temple, *Ammoniac*, and ſometimes, from the country, *Cyreniac*. Since the ceſſation of theſe pilgrimages, no more of this ſalt is produced there; and, from this deficiency, ſome ſuſpect there was never any ſuch thing: But this ſuſpicion is removed, by the large quantities of a ſalt, nearly of the ſame nature, thrown out by mount Ætna. The characters of the ancient ſal armoniac are, that it cools water, turns aqua fortis into aqua regia, and conſequently diſſolves gold.

The modern ſal armoniac is entirely factitious, and made in Egypt; where ſeveral long-necked glaſs bottles, being filled with ſoot, a little ſea-ſalt, and the urine of cattle, and having their mouth luted with a piece of wet cotton, are placed over an oven or furnace, contrived for the purpoſe, in a thick bed of aſhes, nothing but the necks appearing, and kept there two days and a night, with a continual ſtrong fire. The ſteam ſwells up the cotton, and forms a paſte at the vent-hole, hindering the ſalts from evaporating; which, being confined, ſtick to the top of the bottle, and are, upon breaking it, taken out in thoſe large cakes, which they ſend to England. Only ſoot exhaled from dung, is the proper ingredient in this preparation; and the dung of camels affords the ſtrongeſt and beſt. See CHEMISTRY.

ARMORIAL, ſomething relating to arms, or coats of arms. See ARMS.

ARMORY, a warehouſe of arms, or a place where the military habiliments are kept, to be ready for uſe.

ARMORY is alſo a branch of the ſcience of heraldry, conſiſting in the knowledge of coats of arms, as to their blazons and various intendments. See HERALDRY.

ARMOUR denotes ſuch habiliments, as ſerve to defend the body from wounds, eſpecially of darts, a ſword, a lance, *&c.* A complete ſuit of armour formerly conſiſted of a helmet, a ſhield, a cuiraſſe, a coat of mail, a gantlet, *&c.* all now laid aſide.

ARMOURER, a perſon who makes or deals in arms and armour.

ARMS *of courteſy*, or *parade*, were lances not ſhod, ſwords without edge or point, *&c.* uſed in the ancient tournaments. See TOURNAMENT.

Paſs of ARMS, a kind of combat, when anciently two or more cavaliers undertook to defend a paſs againſt all attacks.

ARMS *of armories*, in heraldry, marks of honour borne upon ſhields, banners, and coats, in order to diſtinguiſh ſtates, families, and perſons. See HERALDRY.

Charged ARMS, are ſuch as retain their ancient integrity, with the addition of ſome new honourable bearing.

Canting, or *vocal* ARMS, thoſe in which there are ſome figures alluding to the name of the family.

Full, or *entire* ARMS, ſuch as are not conformable to the rules of heraldry.

ARMS, in falconry, the legs of a hawk from the thigh to the foot.

ARMUYDEN, a ſea-port town of the iſland of Zetland, ſituated at the mouth of the canal of Middleburg, in 2° 35′ E. long. and 51° 30′ N. lat.

ARMY, a large number of ſoldiers, conſiſting of horſe and foot, completely armed, and provided with artillery, ammunition, proviſions, *&c.* under the command of one general, having lieutenant-generals, major-generals, brigadiers, and other officers under him. An army is compoſed of ſquadrons and battalions, and is uſually divided into three corps, and formed into three lines; the firſt line is called the van-guard, the ſecond the main body, and the third the rear-guard, or body of reſerve. The middle of each line is poſſeſſed by the foot; the cavalry form the right and left wing of each line; and ſometimes they place ſquadrons of horſe in the intervals between the battalions. When the army is drawn up in order of battle, the horſe are placed at five feet diſtance from each other, and the foot at three. In each line the battalions are diſtant from each other one hundred and eighty feet, which is nearly equal to the extent of their front; and the ſame holds of the ſquadrons, which are about three hundred feet diſtant, the extent of their own front. Theſe intervals are left for the ſquadrons and battalions of the ſecond line to range themſelves againſt the intervals of the firſt, that both may more readily march through theſe ſpaces to the enemy: the firſt line is uſually three hundred feet diſtant from the ſecond, and the ſecond from the third, that there may be ſufficient room to rally, when the ſquadrons and battalions are broken.

This is to be underſtood of a land army only. A naval, or ſea army, is a number of ſhips of war, equipped and manned with ſailors and mariners, under the command of an admiral, with other inferior officers under him. See NAVY.

ARNAY-LE-DUC, a town of Burgundy in France, ſituated on the river Arroux, in 4° E. long. and 47′ N. lat.

ARNHEIM, a large city of Guelderland, in the United Netherlands, ſituated on the river Lech, about 10 miles north of Nimeguen, in 5° 50′ E. long. and 52° N. lat.

ARNICA, in botany, a genus of the ſyngeneſia polygamia ſuperflua claſs. The receptacle of the arnica is naked; it has a ſimple pappus; and the filaments are five,

five, without antheræ. There are ſeven ſpecies of arnica, all natives of Ethiopia, except the montana and ſcorpioides, which are found in Germany. The leaves and root of the arnica have been eſteemed a ſpecific in reſolving coagulated blood; but their operation is ſo violent, that they are but rarely uſed.

ARNO, a river of Italy, which, after watering Tuſcany, falls into the Mediterranean, below Piſa.

ARNOLDISTS, in church-hiſtory, a ſectary, ſo called from their leader Arnold of Breſſe, who was a great declaimer againſt the wealth and vices of the clergy; and who is alſo charged with preaching againſt baptiſm and the euchariſt.

ARNOT, in botany, the Engliſh name of the bunium. See BUNIUM.

AROLEC, an American weight, equal to 25 of our pounds.

AROMA *philoſophorum*, denotes either ſaffron, or the aroph of Paracelſus, as aroma germanicum denotes elecampane.

AROMATIC, an appellation given to ſuch plants as yield a briſk fragrant ſmell, and a warm taſte, as all kinds of ſpices, *&c.*

ARONA, a fortified town of the Milaneſe, ſituated on the ſouth-weſt part of the lake Maggior, in 8° 50′ E. long. and 45° 40′ N. lat.

ARONCHES, a town of the province of Alentejo, in Portugal, ſituated in 7° 30′ W. long. and 39° N. lat.

ARO-ORCHIS, in botany. See KEMPFERIA.

ARORNOS. See JUNIPERUS.

AROURA, a Grecian meaſure of fifty feet. It was more frequently uſed for a ſquare-meaſure of half the plethorn. The Egyptian aroura was the ſquare of one hundred cubits.

ARQUATA, in ornithology, the trivial name of a ſpecies of ſcolopax. See SCOLOPAX.

ARRACHEE, in heraldry, a term applied to the repreſentations of plants torn up by the roots.

ARRACK. See RACK.

ARRAIGNMENT, in law, the arraigning or ſetting a thing in order, as a perſon is ſaid to arraign a writ of novel diſſeiſin, who prepares and fits it for trial. It is moſt properly uſed to call a perſon to anſwer in form of law upon an indictment, *&c.*

ARRAN, an iſland of Scotland, ſituated in the Frith of Clyde, between Kintire and Cunningham.

ARRAS, a large fortified town of the French Netherlands, capital of the province of Artois, ſituated in 2° 50′ E. long. and 50° 20′ N. lat. It is from this city that the tapeſtry called *arras hangings* takes its denomination.

ARRAS, or *Araxes*, is alſo the name of a river of Georgia, which diſcharges itſelf into the Caſpian ſea.

ARREST, in Engliſh law, the apprehending and reſtraining a perſon, in order to oblige him to be obedient to the law.

ARREST of judgment, the aſſigning juſt reaſons why judgment ſhould not paſs.

ARRESTMENT, in Scots law, ſignifies the ſecuring of a criminal till trial, or till he find caution to ſtand trial, in what are called *bailable crimes*. In civil caſes, it ſignifies either the detaining of ſtrangers or natives *in meditatione fugæ*, till they find caution *judicio ſiſti*, or the attaching the effects of a ſtranger in order to found juriſdiction. See SCOTS LAW, tit. *Juriſdiction and Judges in general*. But, in the moſt general acceptation of the word, it denotes that diligence by which a creditor detains the goods or effects of his debtor in the hands of third parties till the debt due to him be either paid or ſecured. See SCOTS LAW, tit. *Arreſtments and Poindings*.

ARRESTO *facto ſuper bonis*, &c. a writ brought by a denizen againſt the goods of aliens found within this kingdom, as a recompence for goods taken from him in a foreign country.

ARRESTIS, in farriery, mangy tumours upon a horſe's hinder legs, between the ham and the paſtern.

ARRIERE, the hinder or poſterior part of any thing. See REAR.

ARRIERE-*ban*, in the French cuſtoms, is a general proclamation, whereby the king ſummons to the war all that hold of him, both his vaſſals, *i. e.* the nobleſſe, and the vaſſals of his vaſſals.

ARRIERE *fee*, or *fief*, is a fee dependant on a ſuperior one. Theſe fees commenced, when the dukes and counts, rendering their governments hereditary in their families, diſtributed to their officers parts of the royal domains, which they found in their reſpective provinces; and even permitted thoſe officers to gratify the ſoldiers under them in the ſame manner.

ARROE, an iſland of Denmark, ſituated in the Baltic ſea, in 10° 15′ E. long. and 55° 15′ N. lat.

ARRONDEE, in heraldry, a croſs, the arms of which are compoſed of ſections of a circle, not oppoſite to each other, ſo as to make the arms bulge out thicker in one part than another; but the ſections of each arm lying the ſame way, ſo that the arm is every where of an equal thickneſs, and all of them terminating at the edge of the eſcutcheon like the plain croſs.

ARSCHIN, in commerce, a long meaſure uſed in China to meaſure ſtuffs. Four arſchins make three yards of London.

ARSCHOT, a town of the Auſtrian Netherlands, ſituated about fourteen miles eaſt of the city of Mechlin, in 4° 45′ E. long. and 51° 5′ N. lat.

ARSENIC, a poiſonous mineral preparation, which is either white, red, or yellow, prepared from the flowers of cobalt. See COBALT, and CHEMISTRY.

ARSENICAL *Magnet*, a preparation of white arſenic with antimony and ſulphur, ſaid to be a gentle cauſtic.

ARSENOTHELYS, the ſame with hermaphrodite.

ARSIS and *Theſis*, in muſic. A point is ſaid to move arſin and theſin, which riſes in one part and falls in another, and *vice verſa*.

ARSMART, in botany. See PERSICARIA.

ART, a ſyſtem of rules ſerving to facilitate the performance of certain actions.

ART is alſo an appellation given to ſeveral ſuperſtitious practices, as, *St Anſelhm's art*, *St Paul's art*, &c.

ART *and part*, in Scots law. See ACCESSARY.

ARTEDIA,

ARTEDIA, in botany, a genus of the pentandria digynia clafs. The involucrum is pinnatifid; the flofcules of the difk are mafculine, and the fruit is rough. There is only one fpecies, *viz.* the fquamata, a native of Libanium.

ARTEMISIA, fouthernwood, in botany, a genus of the fyngenefia polygamia fuperflua clafs. The receptacle is either naked or a little downy; it has no pappus; the calix is imbricated with roundifh fcales; and the corolla has no radii. There are 23 fpecies of artemifia, only 4 of which are natives of Britain, *viz.* the campeftris, or field-fouthernwood; the maritima, or fea-wormwood; the abfynthium, or common wormwood; and the vulgaris, or mugwort. The vulgaris, or mugwort, is ufed both as a pot-herb and as a medicine; the leaves are principally celebrated as uterine and antihyfteric. The leaves of the abfynthium are chiefly ufed as a bitter or ftomachic.

ARTERIOTOMY, the opening an artery, with defign to procure an evacuation of blood.

ARTERY, in anatomy, a conical tube or canal which conveys the blood from the heart to all parts of the body. See ANATOMY, Part III.

ARTHRITIS, in medicine, the gout. See GOUT, and MEDICINE.

ARTHRODIA, in natural hiftory, a genus of imperfect cryftals, found always in complex maffes, and forming long fingle pyramids, with very fhort and flender columns. See CHRYSTAL.

ARTHRODIA, in anatomy, a fpecies of articulation, wherein a flat head of one bone is received into a fhallow focket of another.

ARTICHOAK, in botany. See CINARA.

ARTICLE, a claufe or condition of a contract, treaty, &c. It is alfo a fmall part or divifion of a difcourfe, a book, or writing, &c.

ARTICLE, in grammar, a particle in moft languages that ferves to exprefs the feveral cafes and genders of nouns, when the language has not different terminanations to denote the different ftates and circumftances of nouns. See GRAMMAR.

ARTICULARIS *morbus.* See GOUT, and MEDICINE.

ARTICULATE *founds* are fuch founds as exprefs the letters, fyllables, or words of any alphabet or language: fuch are formed by the human voice, and by fome few birds, as parrots, &c.

ARTICULATION, in anatomy, denotes the juncture of two bones intended for motion.

ARTIFICER, a perfon whofe employment it is to manufacture any kind of commodity, as in iron, brafs, wood, &c. fuch are fmiths, weavers, carpenters, &c.

ARTIFICIAL, in a general fenfe, denotes fomething made, fafhioned, or produced by art, in contradiftinction from the productions of nature.

ARTILLERY, large fire-arms, with their appurtenances, as cannons, mortars, bombs, petards, mufquets, carabines, &c. See CANNON, MORTAR, GUNNERY.

ARTILLERY-*park*, the place in the rear of both lines in the army, for encamping the artillery, which is drawn up in lines, of which one is formed by the guns; the ammunition-waggons make two or three lines, fixty paces behind the guns, and thirty diftant from one another; the pontoons and tumbrils make the laft line. The whole is furrounded with a rope which forms the park; the gunners and matroffes encamp on the flanks, and the bombardeers, pontoon-men, and artificers, in the rear.

ARTILLERY-*train*, a certain number of pieces of ordnance, mounted on carriages, with all their furniture fit for marching.

ARTILLERY-*company*, a band of infantry, confifting of fix hundred men, making part of the militia or city-guard of London.

ARTISCUS, in medicine. See TROCHE.

ARTOIS, a province of the French Netherlands, fituated between Flanders and Picardy.

ARVALES *fratres*, in Roman antiquity, a college of twelve priefts, inftituted by Romulus, who himfelf made one of the body: they affifted in the facrifices of the ambervalia, offered annually to Ceres and Bacchus, for the profperity of the principal fruits of the earth, *viz.* thofe of corn and wine.

ARUBA, a fmall ifland on the coaft of Terra Firma, fubject to the Dutch, and fituated in 69° 30′ W. long. and 12° 30′ N. lat.

ARUM, in botany, a genus of the gynandria polyandria clafs. There are 22 fpecies of arum, only one of which, *viz.* the maculatum, or water-robin, is a native of Britain. The root of the maculatum is a powerful ftimulant and attenuant.

ARUNCUS, in botany, the trivial name of a fpecies of fpiræa. See SPIRÆA.

ARUNDEL, a town of Suffex, fituated on a river of the fame name, in 30′ W. long. and 50° 45′ N. lat. It gives the title of earl to the noble family of the Howards, and fends two members to parliament.

ARUNDO, in botany, a genus of the triandria digynia clafs. The calix confifts of two valves, and the flofcules are thick and downy. There are fix fpecies of arundo, four of which are natives of Britain, *viz.* the phragmitis, or common red-grafs; the calamogreftis, or branched red grafs; the epigejos, or fmall red-grafs; and the arenaria, or fea red-grafs.

ARUSPICES, or HARUSPICES, an order of priefthood among the Romans, that pretended to foretel future events by infpecting the entrails of victims killed in facrifice; they were alfo confulted on occafion of portents and prodigies.

ARYTÆNOIDES, in anatomy, the name of two cartilages which, together with others, conftitute the head of the larynx. It is alfo applied to fome mufcles of the larynx. See p. 300.

ARYTÆNOIDEUS, in anatomy, one of the mufcles that clofe the larynx. See p. 301.

ARYTHMUS, in medicine, the want of a juft modulation in the pulfe. It is oppofed to eurythmus, a pulfe modulated agreeably to nature.

ARZILLA, a fea-port town of the empire of Morocco, fituated about 15 miles fouth of Tangier, in 5° 40′ W. long. and 35° 40′ N. lat.

AS,

AS, in antiquity, a particular weight, confifting of twelve ounces, being the fame with libra, or the Roman pound. It was alfo the name of a Roman coin, which was of different matter and weight, according to the different ages of the commonwealth. It is alfo ufed to fignify an integer, divifible into twelve parts; from which laft acceptation it fignified a whole inheritance.

ASAFOETIDA, in the materia medica, the concrete juice of a large umbelliferous plant growing in Perfia. This juice exfudes from wounds made in the root of the plant, liquid and white like milk. When expofed to the air, it turns of a brownifh colour, and gradually acquires different degrees of confiftence. It is brought to us in large irregular maffes, compofed of various little fhining grains, which are partly whitifh, partly reddifh, and partly of a violet colour. Thofe maffes are accounted the beft which are clear, of a pale reddifh colour, and variegated with a great number of elegant white tears. This drug has a ftrong fœtid fmell like garlic, and a bitter, acrid, biting tafte. It is frequently ufed in hyfteric and nervous complaints, flatulent colics, and as a promoter of the menfes. It is likewife an ingredient in the officinal gum-pills, and feveral other compofitions.

ASA *dulcis*. See BENZOIN.

ASAPH, or *St* ASAPH, a city of Flintfhire in North Wales, fituated about 20 miles N. W. of Chefter, in 30° 30′ W. long. and 53° 18′ N. lat.

ASAPPES, or AZAPES, in the Turkifh armies, a name given to the auxiliary troops which they raife among the Chriftians under their dominion, and expofe to the firft fhock of the enemy.

ASARABACCA, in botany. See ASARUM.

ASARINA, in botany, a fynonime of the chelone. See CHELONE.

ASARUM, in botany, a genus of the dodecandria monogynia clafs. The afarum is quinquifid, and refts on the germen; it has no corolla. The fpecies are four, only one of which, *viz.* the europæum, is a native of Britain. It is a ftrong fternutatory, and occafions great evacuations, both upwards and downwards.

ASBESTOS, a fort of native foffile ftone, which may be fplit into threads and filaments, from one inch to ten inches in length, very fine, brittle, yet fomewhat tractable, filky, and of a greyifh colour, not unlike talc of Venice. It is almoft infipid to the tafte, indiffoluble in water, and endued with the wonderful property of remaining unconfumed in the fire, which only whitens it. But, notwithftanding the common opinion, in two trials before the Royal Society, a piece of cloth made of this ftone was found to lofe a dram of its weight each time. Paper as well as cloth has been made of it; and Pliny fays he had feen napkins of it, which, being taken foul from the table, were thrown into the fire, and better fcoured than if they had been wafhed in water. This ftone is found in many places of Afia and Europe; particularly in the ifland of Anglefey in Wales, and in Aberdeenfhire in Scotland.

ASCARIS, in zoology, a genus of infects belonging to the order of vermes inteftina. The body of the afcaris is cylindrical, filiform, and tapers at both ends. The fpecies are two, *viz.* 1. The vermicularis is about a quarter of an inch long, and is found in lakes, in the roots of putrid plants, and very frequently in the rectum of children and horfes. 2. The lumbricoides is about the fame length with the lumbricus terreftris, or common earth-worm, but it wants the protuberant ring towards the middle of the body, the only mark by which they can properly be diftinguifhed. The body of the lumbricoides is cylindrical, and fubulated at each extremity; but the tail is fomewhat triangular. The lumbricoides is the worm which is moft commonly found in the human inteftines. For the method of expelling thefe two kinds of infects, fee MEDICINE, *Of worms*.

ASCENDANTS, in law, are oppofed to defcendents in in fucceffion; *i. e.* when a father fucceeds his fon, or an uncle his nephew, *&c.* heritage is faid to afcend, or go to afcendants.

ASCENDENS *obliquus*, the fame with the obliquus internus abdominis. See ANATOMY, p. 192.

ASCENDING, in aftronomy, is faid of fuch ftars as are rifing above the horizon in any parallel of the equator.

ASCENDING *veffels*, in anatomy, thofe which carry the blood upwards, as the aorta afcendens.

ASCENSION, in aftronomy, is either right or oblique. Right afcenfion of the fun, or a ftar, is that degree of the equinoctial, counted from the beginning of aries, which rifes with the fun or ftar in a right fphere. Oblique afcenfion is an arch of the equator intercepted between the firft point of aries, and that point of the equator which rifes together with a ftar in an oblique fphere.

ASCENSION-*day*, a feftival of the Chriftian church, held ten days before Whitfuntide, in memory of our Saviour's afcenfion into heaven after his refurrection.

ASCENSION-*ifland*, an uninhabited ifland, lying almoft in the midway between Africa and Brazil, in 17° W. long. and 7° S. lat.

ASCENSIONAL *difference*, the difference between the right and oblique afcenfion of the fame point to the furface of the fphere. See ASTRONOMY.

ASCENT *of bodies on inclined planes*. See MECHANICS.

ASCENT *of fluids*. See HYDROSTATICS.

ASCETICS, in church-hiftory, fuch Chriftians in the primitive church as enured themfelves to great degrees of abftinence and fafting, in order to fubdue their paffions.

ASCHAFFENBURG, a city of Germany, fituated on the river Mayne, in the circle of the Lower Rhine, about 20 miles eaft of Frankfort, in 9° E. long. and 50° 15′ N. lat.

ASCIDIA, a genus of infects belonging to the order of vermes mollufca. The body is cylindrical and fheathy; it has two apertures towards the top, the one a little lower than the other. There are fix fpecies of this infect, *viz.* the papillofum, gelatinofum, inteftinalis, quadridentata,

quadridentata, ruftica, and echinata, all inhabitants of the ocean.

ASCII, among geographers, an appellation given to thofe inhabitants of the earth who, at certain feafons of the year, have no fhadow: fuch are all the inhabitants of the torrid zone, when the fun is vertical to them.

ASCITES, in medicine, the dropfy. See DROPSY, and MEDICINE.

ASCLEPIAD, in ancient poetry, a verfe compofed of four feet, the firft of which is a fpondee, the fecond a choriambus, and the two laft dactyls; or of four feet and a cæfura, the firft a fpondee, the fecond a dactyl, after which comes the cæfura, then the two dactyls, as,

Mæcenas atavis edite regibus.

ASCLEPIAS, in botany, a genus of the pentandria digynia clafs. The generic character is taken from five oval, concave, horn-like nectaria, which are found in the flower. There are 18 fpecies of afclepias, none of which grow wild in Britain. The root is ufed by the French and German phyficians as a fudorific, diuretic, and emmenagogue; but it is not in ufe with us.

ASCODRUTÆ, in church-hiftory, a fort of Gnoftics, who placed all religion in knowledge; and, under pretence of fpiritual worfhip, would admit of no external or corporeal fymbols whatever.

ASCOLI, a city in the marquifate of Ancona in Italy, fituated on the river Tronto, in 15° E. long. and 42° 50′ N. lat. It is alfo a city of the kingdom of Naples, fituated in the province of Capitonata, in 16° 50′ E. long. and 41° 15′ N. lat.

ASCOLIA, in Grecian antiquity, a feftival celebrated by the Athenian hufbandmen in honour of Bacchus, to whom they facrificed a he-goat, becaufe that animal deftroys the vines.

ASCUS, in natural hiftory, the pouch or bag of the opoffum. See OPOSSUM.

ASCYRUM, in botany, a genus of the polyadelphia polyandria clafs. The calix confifts of four leaves; the corolla has four petals; the filaments are numerous, and divided into four bundles. The fpecies are three, *viz.* the crux andreæ, the hypericoides, and the villofum, all natives of the Weft-Indies or America.

ASELLUS, in zoology, the trivial name of a fpecies of onifcus. See ONISCUS.

ASH, in botany. See FRAXINUS.

ASHBURTON, a town of Devonfhire, fituated about twenty-two miles S. W. of Exeter, in 4° 15′ W. long. and 50° 30′ N. lat.

ASHBY DE LA ZOUCH, a market-town of Leicefterfhire, in 1° 25′ W. long. and 52° 40′ N. lat.

ASHES, the earthy part of wood and other combuftibles, remaining after they are confumed by fire. Thefe, if produced from a vegetable, are of a white colour and faltifh tafte, and, when boiled with fair water, yield a lixivium of an acrimonious, alkaline, fiery, urinous tafte. The afhes of all vegetables are vitrifiable, and are found to contain iron. See AGRICULTURE, and CHEMISTRY.

ASHFORD, a market-town of Kent, fituated about 12 miles S. W. of Canterbury, in 45′ E. long. and 51° 15′ N. lat.

ASIA, one of the four great parts of the world, and the fecond in order. It is bounded on the N. by the Frozen Sea, on the E. by the Eaftern Ocean, which is part of the South Sea, on the S. by the Indian Sea, and on the W. by Europe and Africa. It is of larger extent than any of the three parts in our continent. Arts and fciences were early cultivated here; though they are thought to have come originally from Egypt: but all the confiderable religions now known had their firft beginning in Afia; and there are ftill a great number of people who maintain their ancient tenets, which, according to them, are a hundred thoufand years old. They have one fort of religion in China, and another in India, whofe priefts are the Brachmins; not to mention the Jews, Chriftians, and Mahometans, whofe beginnings are fufficiently known to all the world. This was the feat of feveral ancient empires or monarchies; fuch as that of the Affyrians, Medes, Perfians, and Greeks. It is 4740 miles in length from the Dardanels on the W. to the eaftern fhore of Tartary; and 4380 in breadth from the moft fouthern part of Malacca, to the moft northern cape of Nova Zembla. It may be divided into ten great parts, namely, Turky in Afia, Arabia, Perfia, the Mogul's empire, with the two peninfulas of India, Thibet, China, and Corea; Great and Little Bocharia, with Carazm, Little and Great Tartary, Siberia, and the Iflands. The governments of Afia are generally monarchical; and Turky, Perfia, the Mogul's Empire, Thibet, and China, are fubject to fingle monarchs; but the reft is divided among feveral fovereigns; infomuch that there are reckoned feven emperors, and 30 kings, befides petty princes, and the rajas of India, which are very numerous. With regard to the extent of their religions, the Chriftian is but fmall in refpect of the Mahometan, which comprehends one third of Afia; and the Pagan is near twice as much extended as the Mahometan. Befide thefe, fome pretend there is the natural religion, which has about as many followers as the Chriftian. The languages are fo many and fo various, that it is impoffible to enumerate them; but the chief are the Turkifh, the Grecian, the Arabic, the Chinefe, the Perfian, and the Old Indian. In fhort, every country and ifland has almoft a diftinct language. Befides the animals we have in Europe, there are lions, leopards, tigers, camels, elephants, rhinocerofes, and many others.

Leffer ASIA, the fame with Natolia. See NATOLIA.

ASILUS, or hornet-fly, a genus of infects belonging to the order of infecta diptera. It has two wings, a horny, ftrait, two-valved beak. There are 17 fpecies of this infect.

ASINUS, or Ass, in zoology, the name of a fpecies of equus. See EQUUS.

ASIO, in ornithology, a fynonime of a fpecies of ftrix. See STRIX.

ASISIO, or ASITIO, a city of the pope's territories in Italy, fituated about 16 miles E. of Perugia, in 13° 35′ E. long. and 43° N. lat.

ASLANI, in commerce, a ſilver coin, worth from 115 to 120 aſpers. See ASPER.

ASMER, a province of India, on this ſide the Ganges.

ASPIS, in zoology, the trivial name of a ſpecies of coluber. See COLUBER.

ASPALATHUS, or ROSE-WOOD, in botany, a genus of the diadelphia decandria claſs. The calix conſiſts of five diviſions; the pod is oval, and contains two ſeeds. There are 19 ſpecies, none of them natives of Britain.

ASPARAGUS, in botany, a genus of the hexandria monogynia claſs. The corolla conſiſts of ſix erect diviſions; the three inferior petals are bent outwards; the berry has three cells, and contains two ſeeds. There are 14 ſpecies of aſparagus, only one of which, *viz.* the officinalis, is a native of Britain. This ſpecies is commonly uſed as food; but it is alſo ſuppoſed to promote urine.

ASPECT, in aſtronomy, denotes the ſituation of the planets and ſtars with reſpect to each other. See ASTRONOMY.

ASPEN-TREE, in botany. See POPULUS.

ASPER, in grammar, an accent peculiar to the Greek language, marked thus (ʻ), and importing, that the letters over which it is placed ought to be ſtrongly aſpirated, or pronounced as if an *h* were joined with them.

ASPER, in ichthyology, the trivial name of a ſpecies of perca. See PERCA.

ASPER, or ASPRE, in commerce, a Turkiſh coin, three of which make a medine, and worth ſomething more than our halfpenny.

ASPERA *arteria*, in anatomy, the ſame with the windpipe or trachea. See ANATOMY, p. 281.

ASPERIFOLIATE, or ASPERIFOLIOUS, among botaniſts, ſuch plants as are rough-leaved, having their leaves placed alternately on their ſtalks, and a monopetalous flower divided into five parts.

ASPERUGO, in botany, a genus of the pentandria monogynia claſs. There are two ſpecies, *viz.* the procumbens, or wild buglos, a native of Britain; and the ægyptiaca, a native of Egypt.

ASPERULA, in botany, a genus of the tetrandria monogynia claſs. The corolla is infundibuliform, and the capſule contains two globular ſeeds. There are ſix ſpecies, of which the odorata, or wood-roof, and the cynachica, or ſquinancy-wort, are natives of Britain.

ASPHALTUM, in natural hiſtory, a ſolid, dark, opaque, inflammable ſubſtance, found in Egypt about the Dead Sea, and in many places of Europe, in detached maſſes of no regular ſtructure, breaking eaſily in any direction, very light, fuſible, and, after burning ſome time with a greeniſh white flame, leaving a white reſiduum of aſhes. Dr Hill enumerates three ſpecies of it, the firſt being the bitumen judaicum, which is of a diſcutient quality, promotes the menſtrual diſcharge, and enters as an ingredient into the Venice treacle. See BITUMEN.

ASPHODELUS, in botany, a genus of the hexandria monogynia claſs. The calix is divided into ſix parts; and the nectarium conſiſts of ſix valves covering the germen. There are three ſpecies, *viz.* the buteus, a native of Sicily; the fiſtuloſis and ramoſus, both natives of Spain, *&c.*

ASPHURELATA, in natural hiſtory, are ſemi-metallic foſſils, fuſible by fire, and not malleable in their pureſt ſtate, being in their native ſtate intimately mixed with ſulphur and other adventitious matter, and reduced to what are called ores.

Of this ſeries of foſſils, there are only five bodies, each of which makes a diſtinct genus; and theſe bodies are antimony, biſmuth, cobalt, zinc, or quickſilver. See CHEMISTRY.

ASPIRATE, in grammar, denotes words marked with the ſpiritus aſper. See ASPER.

ASPIRATION, among grammarians, is uſed to denote the pronouncing a ſyllable with ſome vehemence.

ASPLENIUM, in botany, a genus of the cryptogamia filices claſs. The parts of fructification are ſituated in the ſmall ſparſe line under the diſk of the leaves. There are 24 ſpecies, five of which, *viz.* the ſcolopendrium or hart's tongue, the ceterach or ſpleenwort, the trichomanes or common maiden-hair, the viride or green maiden-hair, are natives of Britain. The ceterach is recommended for promoting urine, and as a pectoral.

ASPREDO, in ichthyology, the trivial name of a ſpecies of ſilurus. See SILURUS.

ASS, in zoology, is ranked as a ſpecies of equus, or horſe. See EQUUS.

ASSAI, in muſic, ſignifies quick; and, according to others, that the motion of the piece be kept in a middle degree of quickneſs or ſlowneſs. As, *aſſai allegro, aſſai preſto.* See ALLEGRO, and PRESTO.

ASSARON, or OMER, a meaſure of capacity, in uſe among the Hebrews, containing five pints. It was the meaſure of manna which God appointed for every Iſraelite.

ASSASSIN, a perſon who kills another by attacking him at ſome diſadvantage. It is alſo meant of one who hires himſelf to murder a perſon, in order to revenge the quarrel of another.

ASSAULT, in law, a violent injury offered to a man's perſon, being of a higher nature than battery.

ASSAULT, in the military art, a furious effort made to carry a fortified poſt, camp, or fortreſs, wherein the aſſailants do not ſcreen themſelves by any works: while the aſſault continues, the batteries ceaſe, for fear of killing their own men.

ASSAY, ESSAY, or SAY, in metallurgy, the trial of the goodneſs and purity of metals. Hence,

ASSAYING is the art of finding how much pure metal is contained in any ore, or the proportion of the ſeveral ingredients of any mixed metal. See CHEMISTRY.

ASSAYING of weights and meaſures, the examining the common weights and meaſures by the clerk of the market.

ASSAYING, in muſic, a flouriſhing before one begins to

play;

play; or the running divifions, to lead one into the piece before us.

ASSAY-MASTER, an officer appointed by certain corporations to make a juft affay of all gold and filver brought to him, and to make a true report thereof.

ASSEMBLAGE, the uniting or joining of things together; or the things themfelves fo united or joined. It is alfo ufed, in a more general fenfe, for a collection of various things fo difpofed and diverfified that the whole produces fome agreeable effect.

ASSESSOR, an inferior officer of juftice, appointed chiefly to affift the ordinary judge with his opinion and advice.

Assessor is alfo one who affeffes, or fettles taxes and other public dues.

ASSEVERATION, a pofitive and vehement affirmation of fomething.

ASSIDEANS, in Jewifh antiquity. See Hassideans.

ASSIENTO, a Spanifh word fignifying a farm, in commerce, is ufed for a bargain between the king of Spain and other powers, for importing negroes into the Spanifh dominions in America, and particularly to Buenos Ayres. The firft affiento was made by the French Guinea company; and, by the treaty of Utrecht, transferred to the Englifh, who were to furnifh four thoufand eight hundred negroes annually.

ASSIGN, in common law, a perfon to whom a thing is affigned or made over.

ASSIGNEE, in law, a perfon appointed by another to do an act, tranfact fome bufinefs, or enjoy a particular commodity.

ASSIGNING, in a general fenfe, is the giving over a right to another; and in a fpecial fenfe is ufed to fet forth and point at, as to affign an error, to affign falfe judgment, to affign wafte; in which cafes it muft be fhewn wherein the error is committed, where and how the judgment is unjuft, and where the wafte is committed.

ASSIGNMENT, the transferring the intereft one has in a leafe, or other thing, to another perfon.

ASSIMILATION, in phyfics, is that motion by which bodies convert other bodies related to them, or at leaft fuch as are prepared to be converted, into their own fubftance and nature. Thus, flame multiplies itfelf upon oily bodies, and generates new flame; air upon water, and produces new air; and all the parts, as well fimilar as organical, in vegetables and animals, firft attract with fome election or choice, nearly the fame common or not very different juices for aliment, and afterwards affimilate or convert them to their own nature.

ASSIS, in natural hiftory, a term ufed to denote opium, or the powder of hempfeed, which being formed into boluffes is fwallowed by the Egyptians, who are thereby intoxicated.

ASSISER, or Assizer, *of weights and meafures*, an officer who has the overfight of thofe things. See *Clerk of the market.*

ASSIZE, in law. See Jury.

ASSOCIATION *of ideas*, is where two or more ideas conftantly and immediately follow one another, fo that the one fhall almoft infallibly produce the other. See Metaphysics.

ASSOILZIE, in law, to abfolve, or free.

ASSONANCE, in rhetoric or poetry, is where the words of a phrafe or verfe have nearly the fame found or termination, but make no proper rhyme.

ASSOS, a fea-port town of Natolia, fituated about twelve miles fouth-eaft of Troas, in 27° 30′ E. long. and 38° 30′ N. lat.

ASSUMPSIT, a voluntary or verbal promife, whereby a perfon affumes, or takes upon him to perform or pay any thing to another.

ASSUMPTION, a feftival in the Romifh church, in honour of the miraculous afcent of the Virgin Mary into heaven: the Greek church, who alfo obferve this feftival, celebrate it on the fifteenth of Auguft with great ceremony.

Assumption, in logic, is the minor or fecond propofition in a categorical fyllogifm.

Assumption is alfo ufed for a confequence drawn from the propofitions whereof an argument is compofed.

Assumption, in geography, a city of S. America, fituated near the mouth of the river Plata, and on the oppofite fhore to Buenos Ayres, in 60° W. long. and 34° S. lat.

ASSUMPTIVE *arms*, in heraldry, are fuch as a perfon has a right to affume, with the approbation of his fovereign, and of the heralds: Thus, if a perfon, who has no right by blood, and has no coat of arms, fhall captivate, in any lawful war, any gentleman, nobleman, or prince, he is, in that cafe, intitled to bear the fhield of that prifoner, and enjoy it to him and his heirs for ever.

ASSURANCE, or Insurance, in commerce. See Insurance.

ASSUROR, a merchant, or other perfon, who makes out a policy of affurance, and thereby infures a fhip, houfe, or the like.

ASSYRIA, an ancient empire of Afia, comprehending the modern provinces of Curdiftan, Diarbec, and Irac-arabic.

ASSYTH, or Assythment, in Scots law, fignifies an indemnification made to an injured party. See Scots Law, tit. *Crimes.*

ASTER, in botany, a genus of the fyngenefia polygamia fuperflua clafs. The receptacle is naked; the pappus is fimple; the rays of the corolla are ten; and the calix is imbricated. The fpecies are thirty-fix, only one of which, *viz.* the tripolium, or fea-ftarwort, is a native of Britain.

ASTERABAT, a city of Perfia, capital of a province of the fame name, fituated on the fouthern fhore of the Cafpian fea, in 54° E. long. and 37° 30′ N. lat.

ASTERIA, in natural hiftory, a beautiful pellucid gem of variable colours, as viewed in different lights; called alfo *oculus cati*, or *cat's eye*. The variable colours, which are a pale brown and white, feem to be lodged deep in the ftone, and fhift about as it is moved. It is nearly allied to the opals; from which, however,

however, it is diſtinguiſhed by its colour and ſuperior hardneſs.

ASTERIA is alſo the name of an extraneous foſſil, called in Engliſh the *ſtar-ſtone*. See STAR-STONE.

ASTERIAS, or STAR-FISH, in zoology, a genus of inſects of the order of vermes moluſca. The body is depreſſed, with a hard cruſt, and prickly tentacula: The mouth is in the centre, and has five valves. There are ſixteen ſpecies of aſterias, all found in different ſeas.

ASTERISCUS, in botany, a ſynonime of the anthemis. See ANTHEMIS.

ASTERISK, a mark in form of a ſtar, *, placed over a word or ſentence, to refer the reader to the margin, or elſewhere, for a quotation, explanation, or the like.

ASTEROCEPHALUS, in botany. See SCABIOSA.

ASTEROIDES, in botany. See BUPHTHALMUM.

ASTEROPODIUM, a kind of extraneous foſſil, of the ſame ſubſtance with the aſteriæ, or ſtar-ſtones, to which they ſerve as a baſe. See STAR-STONE.

ASTEROPTERUS, in botany, a ſynonime of the aſter. See ASTER.

ASTHMA, in medicine, a painful, difficult, and laborious reſpiration. See MEDICINE.

ASTI, a city of Peidmont, in Italy, ſituated upon the river Panaro, about thirty miles eaſt of Turin, in 8° 15′ E. long. and 44° 40′ N. lat.

ASTORGA, a city of the province of Leon, in Spain, ſituated upon the river Inerto, about thirty miles ſouth-weſt of Leon, in 6° 20′ W. long. and 42° 20′ N. lat.

ASTOUR, in commerce, a term in the E. Indies, for what in England we call diſcount. See DISCOUNT.

ASTRACAN, a city of Aſiatic Ruſſia, and capital of a kingdom of the ſame name. It is ſituated on the eaſtern ſhore of the river Wolga, about eighty miles north of the Caſpian ſea, in 52° E. long, and 47° N. lat.

ASTRAGAL, in architecture, a little round moulding, in form of a ring, ſerving as an ornament at the tops and bottoms of columns. See ARCHITECTURE.

ASTRAGAL, in gunnery, a round moulding encompaſſing a cannon, about half a foot from its mouth.

ASTRAGALOIDES, in botany, a ſynonime of the phaca. See PHACA.

ASTRAGALUS, in botany, a genus of the diadelphia decandria claſs. The pod is gibbous and bilocular. There are thirty-nine ſpecies of aſtragalus, of which two, *viz.* the glycyphyllus, or wild liquorice, and the arenarius, or purple mountain milk-work, are natives of Britain.

ASTRAGALUS, in anatomy. See p. 185.

ASTRANTIA, in botany, a genus of the pentandria digynia claſs. The involucrum is lanceolated, open, equal, and coloured. The ſpecies are two, *viz.* the major and minor, both natives of the Alps.

ASTRARIUS *hæres*, in law, is where an anceſtor by conveyance has ſettled his heir apparent and family in a houſe in his life-time.

ASTREA, in aſtronomy, the ſame with virgo. See VIRGO, and ASTRONOMY.

ASTRENIUM, in botany, a genus of the diœcia pentandria claſs. There is but one ſpecies, a native of America.

ASTRICTION, in law. See THIRLAGE.

ASTRICTION, among phyſicians, denotes the operation of aſtringent medicines. See the next article.

ASTRINGENTS, in materia medica, ſubſtances diſtinguiſhed by a rough auſtere taſte, and changing ſolutions of iron, eſpecially thoſe made in the vitriolic acid, into a dark purple or black colour; ſuch are galls, tormentil root, biſtort root, balauſtines, terra japanica, acacia, *&c.* Aſtringents yield their virtues by infuſion both to water and vinous ſpirits, but generally in greateſt perfection to the former. The medical effects of aſtringents are, to conſtringe the fibres, and incraſſate or lightly thicken the juices. Their more experienced uſe is in diſorders proceeding from a debility or flaccid ſtate of the ſolids; in hæmorrhages from a thinneſs of the blood, laxity, or rupture of the veſſels; in preternatural diſcharges of other kinds, after the offending matter has been duly corrected or evacuated; and in external relaxations.

ASTROGNOSIA, the ſcience of the fixed ſtars, or the knowlege of their names, conſtellations, magnitudes, *&c.*

ASTROITES, or STAR STONE, in natural-hiſtory, is ſo called on account of its reſemblance to a ſtar. See STAR-STONE.

ASTROLABE, the name for a ſtereographic projection of the ſphere, either upon the plane of the equator, the eye being ſuppoſed to be in the pole of the world; or upon the plane of the meridian, when the eye is ſuppoſed in the point of the interſection of the equinoxial and horizon.

ASTROLABE is alſo an inſtrument for taking the altitude of the ſun or ſtars at ſea. See ASTRONOMY.

ASTROLABE, among the ancients, was the ſame as our armillary ſphere.

ASTROLOGY, a conjectural ſcience, which teaches to judge of the effects and influences of the ſtars, and to foretel future events by the ſituation and different aſpects of the heavenly bodies. This ſcience has long ago become a juſt ſubject of contempt and ridicule.

ASTRONOMICALS, a name ſometimes given to ſexageſimal fractions. See ARITHMETIC, *Of ſexageſimals*.

ASTRONOMY.

ASTRONOMY is the ſcience which treats of the nature and properties of the heavenly bodies.

Chap. I. *Of* Astronomy *in general.*

By aſtronomy we diſcover that the earth is at ſo great a diſtance from the ſun, that if ſeen from thence it would appear no bigger than a point, although its circumference is known to be 25,020 miles. Yet that diſtance is ſo ſmall, compared with the earth's diſtance from the fixed ſtars, that if the orbit in which the earth moves round the ſun were ſolid, and ſeen from the neareſt ſtar, it would likewiſe appear no bigger than a point, although it is at leaſt 162 millions of miles in diameter. For the earth, in going round the ſun, is 162 millions of miles nearer to ſome of the ſtars at one time of the year than at another; and yet their apparent magnitudes, ſituations, and diſtances from one another ſtill remain the ſame; and a teleſcope which magnifies above 200 times does not ſenſibly magnify them; which proves them to be at leaſt 400 thouſands times farther from us than we are from the ſun.

It is not to be imagined that all the ſtars are placed in one concave ſurface, ſo as to be equally diſtant from us; but that they are ſcattered at immenſe diſtances from one another through unlimited ſpace. So that there may be as great a diſtance between any two neighbouring ſtars, as between our ſun and thoſe which are neareſt to him. Therefore an obſerver, who is neareſt any fixed ſtar, will look upon it alone as a real ſun; and conſider the reſt as ſo many ſhining points, placed at equal diſtances from him in the firmament.

By the help of teleſcopes we diſcover thouſands of ſtars which are inviſible to the naked eye; and the better our glaſſes are, ſtill the more become viſible; ſo that no limits can be ſet either to their number or their diſtances.

The ſun appears very bright and large in compariſon of the fixed ſtars, becauſe we keep conſtantly near the ſun, in compariſon of our immenſe diſtance from the ſtars. For a ſpectator, placed as near to any ſtar as we are to the ſun, would ſee that ſtar a body as large and bright as the ſun appears to us: and a ſpectator, as far diſtant from the ſun as we are from the ſtars, would ſee the ſun as ſmall as we ſee a ſtar, diveſted of all its circumvolving planets; and would reckon it one of the ſtars in numbring them.

The ſtars, being at ſuch immenſe diſtances from the ſun, cannot poſſibly receive from him ſo ſtrong a light as they ſeem to have; nor any brightneſs ſufficient to make them viſible to us. For the ſun's rays muſt be ſo ſcattered and diſſipated before they reach ſuch remote objects, that they can never be tranſmitted back to our eyes, ſo as to render theſe objects viſible by reflexion. The ſtars therefore ſhine with their own native and unborrowed luſtre, as the ſun does; and ſince each particular ſtar, as well as the ſun, is confined to a particular portion of ſpace, it is plain that the ſtars are of the ſame nature with the ſun.

It is noways probable that the Almighty, who always acts with infinite wiſdom, and does nothing in vain, ſhould create ſo many glorious ſuns, fit for ſo many important purpoſes, and place them at ſuch diſtances from one another, without proper objects near enough to be benefited by their influences. Whoever imagines they were created only to give a faint glimmering light to the inhabitants of this globe, muſt have a very ſuperficial knowlege of aſtronomy, and a mean opinion of the Divine Wiſdom; ſince, by an infinitely leſs exertion of creating power, the Deity could have given our earth much more light by one ſingle additional moon.

Inſtead then of one ſun and one world only in the univerſe, aſtronomy diſcovers to us ſuch an inconceivable number of ſuns, ſyſtems, and worlds, diſperſed through boundleſs ſpace, that if our ſun, with all the planets, moons, and comets belonging to it, were annihilated, they would be no more miſſed, by an eye that could take in the whole creation, than a grain of ſand from the ſea-ſhore: The ſpace they poſſeſs being comparatively ſo ſmall, that it would ſcarce be a ſenſible blank in the univerſe, although Saturn, the outermoſt of our planets, revolves about the ſun in an orbit of 4884 millions of miles in circumference, and ſome of our comets make excurſions upwards of ten thouſand millions of miles beyond Saturn's orbit; and yet, at that amazing diſtance, they are incomparably nearer to the ſun than to any of the ſtars; as is evident from their keeping clear of the attractive power of all the ſtars, and returning periodically by virtue of the ſun's attraction.

From what we know of our own ſyſtem, it may be reaſonably concluded, that all the reſt are with equal wiſdom contrived, ſituated, and provided with accommodations for rational inhabitants. Let us therefore take a ſurvey of the ſyſtem to which we belong; the only one acceſſible to us; and from thence we ſhall be the better enabled to judge of the nature and end of the other ſyſtems of the univerſe. For although there is almoſt an infinite variety in the parts of the creation which we have opportunities of examining, yet there is a general analogy running through, and connecting all the parts into one great and univerſal ſyſtem.

To an attentive conſiderer, it will appear highly probable, that the planets of our ſyſtem, together with their attendants called *ſatellites* or *moons*, are much of the

the ſame nature with our earth, and deſtined for the like purpoſes. For they are ſolid opaque globes, capable of ſupporting animals and vegetable. Some of them are larger, ſome leſs, and ſome much about the ſize of our earth. They all circulate round the ſun, as the earth does, in a ſhorter or longer time, according to their reſpective diſtances from him; and have, where it would not be inconvenient, regular returns of ſummer and winter, ſpring and autumn. They have warmer and colder climates, as the various productions of our earth require: And, in ſuch as afford a poſſibility of diſcovering it, we obſerve a regular motion round their axes like that of our earth, cauſing an alternate return of day and night; which is neceſſary for labour, reſt, and vegetation, and that all parts of their ſurfaces may be expoſed to the rays of the ſun.

Such of the planets as are fartheſt from the ſun, and therefore enjoy leaſt of his light, have that deficiency made up by ſeveral moons, which conſtantly accompany and revolve about them, as our moon revolves about the earth. The remoteſt planet has, over and above, a broad ring encompaſſing it; which like a lucid zone in the heavens reflects the ſun's light very copiouſly on that planet; ſo that if the remoter planets have the ſun's light fainter by day than we, they have an addition made to it morning and evening by one or more of their moons, and a greater quantity of light in the night-time.

On the ſurface of the moon, becauſe it is nearer us than any other of the celeſtial bodies are, we diſcover a nearer reſemblance of our earth. For, by the aſſiſtance of teleſcopes, we obſerve the moon to be full of high mountains, large valleys, and deep cavities. Theſe ſimilarities leave us no room to doubt, but that all the planets and moons in the ſyſtem are deſigned as commodious habitations for creatures endued with capacities of knowing and adoring their beneficent Creator.

Since the fixed ſtars are prodigious ſpheres of fire like our ſun, and at inconceivable diſtances from one another as well as from us, it is reaſonable to conclude they are made for the ſame purpoſes that the ſun is; each to beſtow light, heat, and vegetation, on a certain number of inhabited planets, kept by gravitation within the ſphere of its activity.

Chap. II. *Of the* Solar System.

The planets and comets which move round the ſun as their centre, conſtitute the Solar Syſtem. Thoſe planets which are near the ſun not only finiſh their circuits ſooner, but likewiſe move faſter in their reſpective orbits, than thoſe which are more remote from him. Their motions are all performed from weſt to eaſt, in orbits nearly circular. Their names, diſtances, bulks, and periodical revolutions, are as follow.

The Sun ☉, an immenſe globe of fire, is placed near the common centre, or rather in the lower focus, of the orbits of all the planets and comets; and turns round his axis in 25 days 6 hours, as is evident by the motion of ſpots ſeen on his ſurface. His diameter is computed to be 763,000 miles; and, by the various attractions of the circumvolving planets, he is agitated by a ſmall motion round the centre of gravity of the ſyſtem. All the planets, as ſeen from him, move the ſame way, and according to the order of ſigns in the graduated circle ♈ ♉ ♊ ♋, *&c.* Plate XL. fig. 2. which repreſents the great ecliptic in the heavens: But, as ſeen from any one planet, the reſt appear ſometimes to go backward, ſometimes forward, and ſometimes to ſtand ſtill; not in circles nor ellipſes, but in looped curves which never return into themſelves. The comets come from all parts of the heavens, and move in all ſorts of directions.

The axis of a planet is a line conceived to be drawn through its centre, about which it revolves as on a real axis. The extremities of this line, terminating in oppoſite points of the planet's ſurface, are called its *poles*. That which points towards the northern part of the heavens, is called the *north pole;* and the other, pointing towards the ſouthern part, is called the *ſouth pole*. A bowl whirled from one's hand into the open air turns round ſuch a line within itſelf, whilſt it moves forward; and ſuch are the lines we mean, when we ſpeak of the axes of the heavenly bodies.

Let us ſuppoſe the earth's orbit to be a thin, even, ſolid plane; cutting the ſun through the centre, and extended out as far as the ſtarry heavens, where it will mark the great circle called the *ecliptic*. This circle we ſuppoſe to be divided into 12 equal parts, called *ſigns;* each ſign into 30 equal parts, called *degrees;* each degree into 60 equal parts, called *minutes;* and every minute into 60 equal parts, called *ſeconds:* So that a ſecond is the 60th part of a minute; a minute the 60th part of a degree; and a degree the 360th part of a circle, or 30th part of a ſign. The planes of the orbits of all the other planets likewiſe cut the ſun in halves; but, extended to the heavens, form circles different from one another, and from the ecliptic; one half of each being on the north ſide, and the other on the ſouth ſide of it. Conſequently the orbit of each planet croſſes the ecliptic in two oppoſite points, which are called the planet's *nodes*. Theſe nodes are all in different parts of the ecliptic; and therefore, if the planetary tracks remained viſible in the heavens, they would in ſome meaſure reſemble the different ruts of waggon-wheels croſſing one another in different parts, but never going far aſunder. That node, or interſection of the orbit of any planet with the earth's orbit, from which the planet aſcends northward above the ecliptic, is called the *aſcending node* of the planet; and the other, which is directly oppoſite thereto, is called its *deſcending node*. Saturn's aſcending node is in 21 deg. 13 min. of Cancer ♋, Jupiter's in 7 deg. 29 min. of the ſame ſign, Mars's in 17 deg 17 min. of Taurus ♉, Venus's in 13 deg. 59 min. of Gemini ♊, and Mercury's in 14 deg. 43 min. of Taurus. Here we conſider the earth's orbit as the ſtandard, and the orbits of all the other planets as oblique to it.

When we ſpeak of the planets orbits, all that is meant is their paths through the open and unreſiſting ſpace in which they move, and are kept in, by the attractive power of the ſun, and the projectile force impreſſed upon

on them at first; between which power and force there is so exact an adjustment, that they continue in the same tracks without any solid orbits to confine them.

Mercury, the nearest planet to the sun, goes round him (as in a circle marked ☿, Plate XXXIX. fig. 1.) in 87 days 23 hours of our time nearly; which is the length of his year. But, being seldom seen, and no spots appearing on his surface or disk, the time of his rotation on his axis, or the length of his days and nights, is as yet unknown. His distance from the sun is computed to be 32 millions of miles, and his diameter 2600. In his course round the sun, he moves at the rate of 95 thousand miles every hour. His light and heat from the sun are almost seven times as great as ours; and the sun appears to him almost seven times as large as to us. The great heat on this planet is no argument against its being inhabited; since the Almighty could as easily suit the bodies and constitutions of its inhabitants to the heat of their dwelling, as he has done ours to the temperature of our earth. And it is very probable that the people there have such an opinion of us, as we have of the inhabitants of Jupiter and Saturn; namely, that we must be intolerably cold, and have very little light at so great a distance from the sun.

This planet appears to us with all the various phases of the moon, when viewed at different times by a good telescope; excepting only that he never appears quite full, because his enlightened side is never turned directly towards us but when he is so near the sun as to be lost to our sight in its beams. And, as his enlightened side is always toward the sun, it is plain that he shines not by any light of his own; for if he did, he would constantly appear round. That he moves about the sun in an orbit within the earth's orbit is also plain, (as will be shewn afterwards), because he is never seen opposite to the sun, nor above 56 times the sun's breadth from his centre.

His orbit is inclined seven degrees to the ecliptic; and that node from which he ascends northward above the ecliptic is in the 14th degree of Taurus; the opposite, in the 14th degree of Scorpio. The earth is in these points on the 6th of November and 4th of May, new style; and when Mercury comes to either of his nodes at his inferior conjunction about these times, he will appear to pass over the disk or face of the sun, like a dark round spot; but in all other parts of his orbit his conjunctions are invisible, because he either goes above or below the sun.

Mr Whiston has given us an account of several periods at which Mercury may be seen on the sun's disk, *viz.* in the year 1782, Nov. 12th, at 3 h. 44 m. in the afternoon; 1786, May 4th, at 6 h. 57 m. in the forenoon; 1789, Dec. 6th, at 3 h. 55 min. in the afternoon; and 1799, May 7th, at 2 h. 34 m. in the afternoon. There will be several intermediate transits, but none of them visible to us.

Venus, the next planet in order, is computed to be 59 millions of miles from the sun; and by moving at the rate of 69 thousand miles every hour in her orbit, (as in the circle marked ♀), she goes round the sun in 224 days 17 hours of our time nearly. But though this be the full length of her year, as she performs only $9\frac{1}{4}$ revolutions on her own axis in that time, her year consists only of $9\frac{1}{4}$ days; so that in her, every day and night together is as long as $24\frac{1}{3}$ days and nights with us. This odd quarter of a day in every year makes every fourth year a leap-year to Venus; as the like does to our earth. Her diameter is 7906 miles; and by her diurnal motion the inhabitants about her equator are carried 43 miles every hour, besides the 69,000 above mentioned.

Her orbit includes that of Mercury within it; for at her greatest elongation, or apparent distance from the sun, she is 96 times his breadth from his centre; which is almost double of Mercury's. Her orbit is included by the earth's; for if it were not, she might be seen as often in opposition to the sun, as she is in conjunction with him; but she was never seen 90 degrees, or a fourth part of a circle, from the sun.

When Venus appears west of the sun, she rises before him in the morning, and is called the *morning-star*; when she appears east of the sun, she shines in the evening after he sets, and is then called the *evening-star*; being each in its turn for 290 days. It may perhaps be surprising at first, that Venus should keep longer on the east or west of the sun, than the whole time of her period round him. But the difficulty vanishes when we consider, that the earth is all the while going round the sun the same way, though not so quick as Venus; and therefore her relative motion to the earth must in every period be as much slower than her absolute motion in her orbit, as the earth during that time advances forward in the ecliptic, which is 220 degrees. To us she appears, through a telescope, in all the various shapes of the moon.

The axis of Venus is inclined 75 degrees to the axis of her orbit; which is $51\frac{1}{2}$ degrees more than our earth's axis is inclined to the axis of the ecliptic; and therefore her seasons vary much more than ours do. The north pole of her axis inclines toward the 20th degree of aquarius, our earth's to the beginning of Cancer; consequently the northern parts of Venus have summer in the signs where those of our earth have winter, and *vice versa*.

The artificial day at each pole of Venus is as long as $112\frac{1}{2}$ natural days on our earth.

The sun's greatest declination on each side of her equator amounts to 75 degrees; therefore her tropics are only 15 degrees from her poles, and her polar circles as far from her equator. Consequently, the tropics of Venus are between her polar circles and her poles; contrary to what those of our earth are.

As her annual revolution contains only $9\frac{1}{4}$ of her days, the sun will always appear to go through a whole sign, or twelfth part of her orbit, in little more than three quarters of her natural day, or nearly in $18\frac{3}{4}$ of our days and nights.

Because her day is so great a part of her year, the sun changes his declination in one day so much, that if he passes vertically, or directly over head of any given place on the tropic, the next day he will be 26 degrees from

from it; and whatever place he paſſes vertically over when in the equator, one day's revolution will remove him $36\frac{1}{4}$ degrees from it. So that the ſun changes his declination every day in Venus about 14 degrees more at a mean rate, than he does in a quarter of a year on our earth. This appears to be providentially ordered, for preventing the too great effects of the ſun's heat, (which is twice as great on Venus as on the earth), ſo that he cannot ſhine perpendicularly on the ſame places for two days together; and by that means the heated places have time to cool.

If the inhabitants about the north pole of Venus fix their ſouth or meridian line through that part of the heavens where the ſun comes to his greateſt height, or north declination, and call thoſe the eaſt and weſt points of their horizon, which are 90 degrees on each ſide from that point where the horizon is cut by the meridian line, theſe inhabitants will have the following remarkable things.

The ſun will riſe $22\frac{1}{2}$ degrees north of the eaſt; and going on $112\frac{1}{2}$ degrees, as meaſured on the plane of the horizon, he will croſs the meridian at an altitude of $12\frac{1}{2}$ degrees; then making an entire revolution without ſetting, he will croſs it again at an altitude of $48\frac{1}{2}$ degrees; at the next revolution he will croſs the meridian as he comes to his greateſt height and declination, at the altitude of 75 degrees; being then only 15 degrees from the zenith, or that point of the heavens which is directly over head; and thence he will deſcend in the like ſpiral manner, croſſing the meridian firſt at the altitude of $48\frac{1}{2}$ degrees; next at the altitude of $12\frac{1}{2}$ degrees; and going on thence $112\frac{1}{2}$ degrees, he will ſet $22\frac{1}{2}$ degrees north of the weſt; ſo that, after having been $4\frac{5}{8}$ revolutions above the horizon, he deſcends below it to exhibit the like appearances at the ſouth pole.

At each pole, the ſun continues half a year without ſetting in ſummer, and as long without riſing in winter; conſequently the polar inhabitants of Venus have only one day and one night in the year, as it is at the poles of our earth. But the difference between the heat of ſummer and cold of winter, or of mid-day and midnight, on Venus, is much greater than on the earth; becauſe in Venus, as the ſun is for half a year together above the horizon of each pole in its turn, ſo he is for a conſiderable part of that time near the zenith; and during the other half of the year always below the horizon, and for a great part of that time at leaſt 70 degrees from it. Whereas, at the poles of our earth, although the ſun is for half a year together above the horizon, yet he never aſcends above, nor deſcends below it, more than $23\frac{1}{2}$ degrees. When the ſun is in the equinoctial, or in that circle which divides the northern half of the heavens from the ſouthern, he is ſeen with one half of his diſk above the horizon of the north pole, and the other half above the horizon of the ſouth pole; ſo that his centre is in the horizon of both poles: and then deſcending below the horizon of one, he aſcends gradually above that of the other. Hence, in a year, each pole has one ſpring, one harveſt, a ſummer as long as them both, and a winter equal in length to the other three ſeaſons.

At the polar circles of Venus, the ſeaſons are much the ſame as at the equator, becauſe there are only 15 degrees betwixt them; only the winters are not quite ſo long, nor the ſummers ſo ſhort; but the four ſeaſons come twice round every year.

At Venus's tropics, the ſun continues for about fifteen of our weeks together without ſetting in ſummer, and as long without riſing in winter. Whilſt he is more than 15 degrees from the equator, he neither riſes to the inhabitants of the one tropic, nor ſets to thoſe of the other; whereas, at our terreſtrial tropics, he riſes and ſets every day of the year.

At Venus's tropics, the ſeaſons are much the ſame as at her poles; only the ſummers are a little longer, and the winters a little ſhorter.

At her equator, the days and nights are always of the ſame length, and yet the diurnal and nocturnal arches are very different, eſpecially when the ſun's declination is about the greateſt; for then his meridian altitude may ſometimes be twice as great as his midnight depreſſion, and at other times the reverſe. When the ſun is at his greateſt declination, either north or ſouth, his rays are as oblique at Venus's equator, as they are at London on the ſhorteſt day of winter. Therefore, at her equator there are two winters, two ſummers, two ſprings, and two autumns every year. But becauſe the ſun ſtays for ſome time near the tropics, and paſſes ſo quickly over the equator, every winter there will be almoſt twice as long as ſummer; the four ſeaſons returning twice in that time, which conſiſts only of $9\frac{1}{4}$ days.

Thoſe parts of Venus which lie between the poles and tropics, and between the tropics and polar circles, and alſo between the polar circles and equator, partake more or leſs of the phenomena of theſe circles as they are more or leſs diſtant from them.

From the quick change of the ſun's declination it happens, that if he riſes due eaſt on any day, he will not ſet due weſt on that day, as with us; for if the place where he riſes due eaſt be on the equator, he will ſet on that day almoſt weſt-north-weſt, or about $18\frac{1}{2}$ degrees north of the weſt. But if the place be in 45 degrees north latitude, then on the day that the ſun riſes due eaſt he will ſet north-weſt by weſt, or 33 degrees north of the weſt, and in 62 degrees north latitude. When he riſes in the eaſt, he ſets not in that revolution, but juſt touches the horizon 10 degrees to the weſt of the north point, and aſcends again, continuing for $3\frac{1}{4}$ revolutions above the horizon without ſetting. Therefore, no place has the forenoon and afternoon of the ſame day equally long, unleſs it be in the equator, or at the poles.

The ſun's altitude at noon, or at any other time of the day, and his amplitude at riſing and ſetting, being very different at places on the ſame parallel of latitude, according to the different longitudes of thoſe places, the longitude will be almoſt as eaſily found on Venus as the latitude is found on the earth; which is an advantage we can never enjoy, becauſe the daily change of the ſun's declination is by much too ſmall for that important purpoſe.

On this planet, where the ſun croſſes the equator in any year, he will have 9 degrees of declination from that

place

place on the ſame day and hour next year, and will croſs the equator 90 degrees farther to the weſt; which makes the time of the equinox a quarter of a day (or about ſix of our days) later every year. Hence, although the ſpiral in which the ſun's motion is performed, be of the ſame ſort every year, yet it will not be the very ſame, becauſe the ſun will not paſs vertically over the ſame places till four annual revolutions are finiſhed.

Venus's orbit is inclined $3\frac{1}{2}$ degrees to the earth's; and croſſes it in the 14th degree of Gemini and of Sagittarius; and therefore, when the earth is about theſe points of the ecliptic at the time that Venus is in her inferior conjunction, ſhe will appear like a ſpot on the ſun, and afford a more certain method of finding the diſtances of all the planets from the ſun, than any other yet known. But theſe appearances happen very ſeldom. The firſt was in the year 1639. The ſecond in the year 1761, June 6. In the morning of that day, when the ſun roſe at London, Venus had paſſed both the external and internal contacts. At 38 minutes 21 ſeconds paſt 7 o'clock, (apparent time) at Greenwich, the Rev. Dr Bliſs, aſtronomer royal, firſt ſaw Venus on the ſun; at which inſtant, the centre of Venus preceded the ſun's centre, by $6' 18''.9$ of right aſcenſion, and was ſouth of the ſun's centre by $18' 42''.1$ of declination.—From that time to the beginning of egreſs, the Doctor made ſeveral obſervations, both of the difference of right aſcenſion and declination of the centres of the ſun and Venus; and at laſt found the beginning of egreſs, or inſtant of the internal contact of Venus with the ſun's limb, to be at 8 hours 19 minutes 0 ſeconds apparent time.—From the Doctor's own obſervations, and thoſe which were made at Shirburn by another gentleman, he has computed, that the mean time at Greenwich of the ecliptical conjunction of the ſun and Venus was at 51 minutes 20 ſeconds after 5 o'clock in the morning; that the place of the ſun and Venus was Gemini $15° 36' 33''$; that the geocentric latitude of Venus was $9' 44''.9$ ſouth,—her horary motion from the ſun $3' 57''.13$ retrograde, and the angle then formed by the axis of the equator and the axis of the ecliptic was $6° 9' 34''$, decreaſing hourly 1 minute of a degree.—By the mean of three good obſervations, the diameter of Venus on the ſun was $58''$.

Mr Short made his obſervations at Savile-houſe, in London, 30 ſeconds in time weſt from Greenwich, in preſence of his royal highneſs the duke of York, accompanied by their royal highneſſes prince William, prince Henry, and prince Frederick.—He firſt ſaw Venus on the ſun, through flying clouds, at 46 minutes 37 ſeconds after 5 o'clock; and at 6 hours 15 minutes 12 ſeconds he meaſured the diameter of Venus $59''.8$.—He afterward found it to be $58''.9$, when the ſky was more favourable.—And, through a reflecting teleſcope of two feet focus, magnifying 140 times, he found the internal contact of Venus with the ſun's limb to be at 8 hours 18 minutes $21\frac{1}{2}$ ſeconds, apparent time; which being reduced to the apparent time at Greenwich, was 8 hours 18 minutes $51\frac{1}{2}$ ſeconds; ſo that his time of ſeeing the contact was $8\frac{1}{2}$ ſeconds ſooner (in abſolute time) than the inſtant of its being ſeen at Greenwich.

Meſſrs Ellicott and Dollond obſerved the internal contact at Hackney; and their time of ſeeing it, reduced to the time at Greenwich, was at 8 hours 18 minutes 56 ſeconds, which was 4 ſeconds ſooner in abſolute time than the contact was ſeen at Greenwich.

Mr Canton in Spittle-Square, London, $4' 11''$ weſt of Greenwich, (equal to 16 ſeconds 44 thirds of time), meaſured the ſun's diameter $31' 33'' 24'''$, and the diameter of Venus on the ſun $58''$; and, by obſervation, found the apparent time of the internal contact of Venus with the ſun's limb to be at 8 hours 18 minutes 41 ſeconds; which, by reduction, was only $2\frac{1}{4}$ ſeconds ſhort of the time at the Royal Obſervatory at Greenwich.

The Reverend Mr Richard Haydon, at Leſkeard in Cornwall, (16 minutes 10 ſeconds in time weſt from London, as ſtated by Dr Bevis), obſerved the internal contact to be at 8 hours 0 minutes 20 ſeconds, which, by reduction, was 8 hours 16 minutes 30 ſeconds at Greenwich; ſo that he muſt have ſeen it 2 minutes 30 ſeconds ſooner in abſolute time than it was ſeen at Greenwich;—a difference by much too great to be occaſioned by the difference of parallaxes. But by a memorandum of Mr Hayden's ſome years before, it appears that he then ſuppoſed his weſt longitude to be near two minutes more; which brings his time to agree within half a minute of the time at Greenwich; to which the parallaxes will very nearly anſwer.

At Stockholm Obſervatory, latitude $59° 20'\frac{1}{2}$ north, and longitude 1 hour 12 minutes eaſt from Greenwich, the whole of the tranſit was viſible: the total ingreſs was obſerved by Mr Wargentin to be at 3 hours 39 minutes 23 ſeconds in the morning, and the beginning of egreſs at 9 hours 30 minutes 8 ſeconds; ſo that the whole duration between the two internal contacts, as ſeen at that place, was 5 hours 50 minutes 45 ſeconds.

At Torneo in Lapland, (1 hour 27 minutes 28 ſeconds eaſt of Paris), Mr Hellant, who is eſteemed a very good obſerver, found the total ingreſs to be at 4 hours 3 minutes 59 ſeconds, and the beginning of egreſs to be 9 hours 54 minutes 8 ſeconds.—So that the whole duration between the two internal contacts was 5 hours 50 minutes 9 ſeconds.

At Hernoſand in Sweden, (latitude $6° 38'$ north, and longitude 1 hour 2 minutes 12 ſeconds eaſt of Paris), Mr Giſter obſerved the total ingreſs to be at 3 hours 38 minutes 26 ſeconds; and the beginning of egreſs to be at 9 hours 29 minutes 21 ſeconds;—the duration between theſe two internal contacts 5 hours 50 minutes 56 ſeconds.

Mr De La Lande, at Paris, obſerved the beginning of egreſs to be at 8 hours 28 minutes 26 ſeconds apparent time.—But Mr Ferner (who was then at Conflans, $14''\frac{1}{2}$ weſt of the Royal Obſervatory at Paris) obſerved the beginning of egreſs to be at 8 hours 28 minutes 29 ſeconds true time. The equation, or difference between the true and apparent time, was 1 minute 54 ſeconds.—The total ingreſs, being before the ſun roſe, could not be ſeen.

At Tobolſk in Siberia, Mr Chappe obſerved the total ingreſs to be at 7 hours 0 minutes 28 ſeconds in the morning, and the beginning of egreſs to be at 49 minutes $20\frac{1}{2}$ ſeconds after 12 at noon.—So that the whole duration of the tranſit between the internal contacts was 5 hours

hours 48 minutes 52½ feconds, as feen at that place; which was 2 minutes 3½ feconds lefs than as feen at Hernofand in Sweden.

At Madrafs, the Reverend Mr Hirft obferved the total ingrefs to be at 7 hours 47 minutes 55 feconds apparent time in the morning, and the beginning of egrefs at 1 hour 39 minutes 38 feconds paft noon.—The duration between thefe two internal contacts was 5 hours 51 minutes 43 feconds.

Profeffor Mathenci at Bologna obferved the beginning of egrefs to be at 9 hours 4 minutes 58 feconds.

At Calcutta, (latitude 22° 30′ north, nearly 92° eaft longitude from London), Mr William Magee obferved the total ingrefs to be at 8 hours 20 minutes 58 feconds in the morning, and the beginning of egrefs to be at 2 hours 11 minutes 34 feconds in the afternoon; the duration between the two internal contacts 5 hours 50 minutes 36 feconds.

At the Cape of Good Hope, (1 hour 13 minutes 35 feconds eaft from Greenwich), Mr Mafon obferved the beginning of egrefs to be at 9 hours 39 minutes 50 feconds in the morning.

All thefe times are collected from the obfervers accounts, printed in the Philofophical Tranfactions for the years 1762 and 1763, in which there are feveral other other accounts that are not tranfcribed.—The inftants of Venus's total exit from the fun are likewife mentioned, but they are here left out, as not of any ufe for finding the fun's parallax.

Whoever compares thefe times of the internal contacts, as given in by different obfervers, will find fuch differences among them, even thofe which were taken upon the fame fpot, as will fhew, that the inftant of either contact could not be fo accurately perceived by the obfervers as Dr Halley thought it could; which probably arifes from the difference of peoples eyes, and the different magnifying powers of thofe telefcopes through which the contacts were feen.—If all the obfervers had made ufe of equal magnifying powers, there can be no doubt but that the times would have more nearly coincided; fince it is plain, that fuppofing all their eyes to be equally quick and good, they whofe telefcopes magnified moft would perceive the point of internal contact fooneft, and of the total exit lateft.

Mr Short, in a paper publifhed in the Philofophical Tranfactions, Vol. LII. Part II. has taken an incredible deal of pains in deducing the quantity of the fun's parallax, from the beft of thofe obfervations which were made both in Britain and abroad; and finds it to have been 8″.52 on the day of the tranfit when the fun was very nearly at his greateft diftance from the earth; and confequently 8″.65 when the fun is at his mean diftance from the earth.

The log. fine (or tangent) of 8″.65 is 5.6219140, which being fubtracted from the radius 10.0000000, leaves remaining the logarithm 4.3780860, whofe number is 23882.84; which is the number of femidiameters of the earth that the fun is diftant from it.—And this laft number, 23882.84, being multiplied by 3985, the number of Englifh miles contained in the earth's femidiameter, gives 95,173,117 miles from the earth's mean diftance from the fun.—But becaufe it is impoffible, from the niceft obfervations of the fun's parallax, to be fure of his true diftance from the earth within 100 miles, we fhall at prefent, for the fake of round numbers, ftate the earth's mean diftance from the fun at 95,173,000 Englifh miles.

And then, from the numbers and analogies in § 11. & 14. of Mr Short's differtation, we find the mean diftances of all the reft of the planets from the fun, in miles, to be as follows.—Mercury's diftance, 36,841,468; Venus's diftance, 68,891,486; Mars's diftance, 145,014,148; Jupiter's diftance, 494,990,976; and Saturn's diftance, 907,956,130.

The femidiameter of the earth's annual orbit being equal to the earth's mean diftance from the fun, *viz.* 95,173,000 miles, the whole diameter thereof is 190,346,000 miles. And fince the circumference of a circle is to its diameter as 355 is to 113, the circumference of the earth's orbit is 597,989,646 miles.

And, as the earth defcribes this orbit in 365 days 6 hours (or in 8766 hours) it is plain that it travels at the rate of 68,216.9 miles every hour; and confequently 1136.9 miles every minute; fo that its velocity in its orbit is at leaft 142 times as great as the velocity of a cannon-ball, fuppofing the ball to move through 8 miles in a minute, which it is found to do very nearly: And at this rate it would take 22 years 228 days for a cannonball to go from the earth to the fun.

On the 3d of June, in the year 1769, Venus again paffed over the fun's difk, in fuch a manner, as to afford a much eafier and better method of inveftigating the fun's parallax than her tranfit in the year 1761. But as few of the obfervations upon this tranfit have as yet been made public, we can only give the following, made by different obfervers at London.

	External contact.			Regular circumferences in contact.			Thread of light compleated, or the internal contact.			Telefcopes made ufe of.	Magnifying power.
	h.	′	″	h.	′	″	h.	′	″		
N. Mafkelyne,	7	10	58	7	28	31	7	29	23	2 feet reflector,	140
M. Hitchins,	7	10	54	7	28	47	7	28	57	6 f. reflector,	90
W. Hirft,	7	11	11	———			7	29	18	2 f. reflector,	55
J. Horfley,	7	10	44	7	28	15	7	29	28	10 f. achromatic,	50
S. Dunn,	7	10	37	7	29	28	7	29	48	3½ f. achromatic,	140
P. Dollond,	7	11	19	———			7	29	20	3½ f. achromatic,	150
E. Nairne,	7	11	30	———			7	29	20	2 f. reflector,	120

When

When Venus was little more than half emerged into the ſun's diſk. Mr Maſkelyne ſaw her whole circumference compleated, by means of a vivid, but narrow and ill defined border of light, which illuminated that part of her circumference which was off the ſun, and otherwiſe not viſible." They all obſerved the black protuberance in the internal contact. They likewiſe, after the internal contact, ſaw a luminous ring round the body of Venus, about the thickneſs of half her ſemi-diameter; it was brighteſt towards Venus's body, and gradually diminiſhed in ſplendor at greater diſtance, but the whole was exceſſive white and faint.

Venus may have a ſatellite or moon, although it be undiſcovered by us: which will not appear very ſurpriſing, if we conſider how inconveniently we are placed from ſeeing it. For its enlightened ſide can never be fully turned towards us, but when Venus is beyond the ſun; and then, as Venus appears little bigger than an ordinary ſtar, her moon may be too ſmall to be perceived at ſuch a diſtance. When ſhe is between us and the ſun, her full moon has its dark ſide towards us; and then we cannot ſee it any more than we can our own moon at the time of change. When Venus is at her greateſt elongation, we have but one half of the enlightened ſide of her full moon towards us; and even then it may be too far diſtant to be ſeen by us.

The Earth is the next planet above Venus in the ſyſtem. It is 82 millions of miles from the ſun, and goes round him (as in the circle ⊕) in 365 days 5 hours 49 minutes, from any equinox or ſolſtice to the ſame again; but from any fixed ſtar to the ſame again, as ſeen from the ſun, in 365 days 6 hours and 9 minutes; the former being the length of the tropical year, and the latter the length of the ſyderial. It travels the rate of 58 thouſand miles every hour; which motion, though 120 times ſwifter than that of a cannon-ball, is little more than half as ſwift as Mercury's motion in his orbit. The earth's diameter is 7970 miles; and by turning round its axis every 24 hours from weſt to eaſt, it cauſes an apparent diurnal motion of all the heavenly bodies from eaſt to weſt. By this rapid motion of the earth on its axis, the inhabitants about the equator are carried 1042 miles every hour, whilſt thoſe on the parallel of London are carried only about 580, beſides the 58 thouſand miles by the annual motion above mentioned, which is common to all places whatever.

The earth's axis makes an angle of 23½ degrees with the axis of its orbit, and keeps always the ſame oblique direction, inclining towards the ſame fixed ſtars throughout its annual courſe, which cauſes the returns of ſpring, ſummer, autumn, and winter; as will be explained afterwards.

The earth is round like a globe; as appears, 1. By its ſhadow in eclipſes of the moon, which ſhadow is always bounded by a circular ring. 2. By our ſeeing the maſts of a ſhip whilſt the hull is hid by the convexity of the water. 3. By its having been ſailed round by many navigators. The hills take off no more from the roundneſs of the earth in compariſon, than grains of duſt do from the roundneſs of a common globe.

The ſeas and unknown parts of the earth (by a meaſurement of the beſt maps) contain 160 million 522 thouſand and 26 ſquare miles; the inhabited parts 38 million 990 thouſand 569: Europe 4 million 456 thouſand and 65; Aſia, 10 million 768 thouſand 823; Africa, 9 million 654 thouſand 807; America, 14 million 110 thouſand 874. In all, 199 million 512 thouſand 595; which is the number of ſquare miles on the whole ſurface of our globe.

The Moon is not a planet, but only a ſatellite or attendant of the earth; going round the earth from change to change in 29 days 12 hours and 44 minutes; and round the ſun with it every year. The moon's diameter is 2180 miles; and her diſtance from the earth's centre 240 thouſand. She goes round her orbit in 27 days 7 hours 43 minutes, moving about 2290 miles every hour; and turns round her axis exactly in the ſame time that ſhe goes round the earth, which is the reaſon of her keeping always the ſame ſide towards us, and that her day and night, taken together, is as long as our lunar month.

The moon is an opaque globe like the earth, and ſhines only by reflecting the light of the ſun: Therefore whilſt that half of her which is toward the ſun is enlightened, the other half muſt be dark and inviſible. Hence, ſhe diſappears when ſhe comes between us and the ſun; becauſe her dark ſide is then towards us. When ſhe is gone a little way forward, we ſee a little of her enlightened ſide; which ſtill encreaſes to our view, as ſhe advances forward, until ſhe comes to be oppoſite the ſun; and then her whole enlightened ſide is towards the earth, and ſhe appears with a round, illumined orb, which we call the *full moon*; her dark ſide being then turned away from the earth. From the full ſhe ſeems to decreaſe gradually as ſhe goes through the other half of her courſe; ſhewing us leſs and leſs of her enlightened ſide every day, till her next change or conjunction with the ſun, and then ſhe diſappears as before.

This continual change of the moon's phaſes demonſtrates that ſhe ſhines not by any light of her own; for if ſhe did, being globular, we ſhould always ſee her with a round full orb like the ſun. Her orbit is repreſented in the ſcheme by the little circle *m*, upon the earth's orbit ⊕, Plate XXXIX. fig. 1.; but it is drawn fifty times too large in proportion to the earth's; and yet is almoſt too ſmall to be ſeen in the diagram.

The moon has ſcarce any difference of ſeaſons; her axis being almoſt perpendicular to the ecliptic. What is very ſingular, one half of her has no darkneſs at all; the earth conſtantly affording it a ſtrong light in the ſun's abſence; while the other half has a fortnight's darkneſs, and a fortnight's light by turns.

Our earth is a moon to the moon, waxing and waning regularly, but appearing thirteen times as big, and affording her thirteen times as much light as ſhe does to us. When ſhe changes to us, the earth appears full to her; and when ſhe is in her firſt quarter to us, the earth is in its third quarter to her; and *vice verſa*.

But from one half of the moon, the earth is never ſeen at all; from the middle of the other half, it is always ſeen over head; turning round almoſt thirty times as quick as the moon does. From the circle which limits our view of the moon, only one half of the earth's ſide

ſide next her is ſeen; the other half being hid below the horizon of all places on that circle. To her the earth ſeems to be the largeſt body in the univerſe, for it appears thirteen times as large as ſhe does to us.

The moon has no atmoſphere of any viſible denſity ſurrounding her; for if ſhe had, we could never ſee her edge ſo well defined as it appears; but there would be a ſort of a miſt or hazineſs around her, which would make the ſtars look fainter, when they are ſeen through it. But obſervation proves, that the ſtars which diſappear behind the moon retain their full luſtre until they ſeem to touch her very edge, and then they vaniſh in a moment. The faint light which has been ſeen all around the moon in total eclipſes of the ſun, has been obſerved, during the time of darkneſs, to have its centre coincident with the centre of the ſun; and was therefore much more likely to ariſe from the atmoſphere of the ſun than from that of the moon; for if it had been owing to the latter, its centre would have gone along with the moon's.

If there were ſeas in the moon, ſhe could have no clouds, rains, nor ſtorms, as we have; becauſe ſhe has no ſuch atmoſphere to ſupport the vapours which occaſion them. And every one knows, that when the moon is above our horizon in the night-time, ſhe is viſible, unleſs the clouds of our atmoſphere hide her from our view, and all parts of her appear conſtantly with the ſame clear, ſerene, and calm aſpect. But thoſe dark parts of the moon, which were formerly thought to be ſeas, are now found to be only vaſt deep cavities, and places which reflect not the ſun's light ſo ſtrongly as others, having many caverns and pits, whoſe ſhadows fall within them, and are always dark on the ſides next the ſun, which demonſtrates their being hollow; and moſt of theſe pits have little knobs like hillocks ſtanding within them, and caſting ſhadows alſo; which cauſe theſe theſe places to appear darker than others which have fewer or leſs remarkable caverns. All theſe appearances ſhew, that there are no ſeas in the moon; for if there were any, their ſurfaces would appear ſmooth and even, like thoſe on the earth.

There being no atmoſphere about the moon, the heavens in the day-time have the appearance of night to a lunarian who turns his back toward the ſun; and when he does, the ſtars appear as bright to him as they do in the night to us. For it is entirely owing to our atmoſphere that the heavens are bright about us in the day.

As the earth turns round its axis, the ſeveral continents, ſeas, and iſlands appear to the moon's inhabitants like ſo many ſpots of different forms and brightneſs, moving over its ſurface, but much fainter at ſome times than others, as our clouds cover them or leave them. By theſe ſpots, the lunarians can determine the time of the earth's diurnal motion, juſt as we do the motion of the ſun; and perhaps they meaſure their time by the motion of the earth's ſpots, for they cannot have a truer dial.

The moon's axis is ſo nearly perpendicular to the ecliptic, that the ſun never removes ſenſibly from her equator; and the obliquity of her orbit, being only $5\frac{1}{3}$ degrees, which is next to nothing as ſeen from the ſun, cannot cauſe the ſun to decline ſenſibly from her equator. Yet her inhabitants are not deſtitute of means for aſcertaining the length of their year, though their method and ours muſt differ. For we can know the length of our year by the return of our equinoxes; but the lunarians, having always equal day and night, muſt have recourſe to another method; and we may ſuppoſe, they meaſure their year by obſerving when either of the poles of our earth begins to be enlightened, and the other to diſappear, which is always at our equinoxes, they being conveniently ſituated for obſerving great tracks of land about our earth's poles, which are entirely unknown to us. Hence we may conclude, that the year is of the ſame abſolute length both to the earth and moon, though very different as to the number of days; we having $365\frac{1}{4}$ natural days, and the lunarians only $12\frac{7}{19}$; every day and night in the moon being as long as $29\frac{1}{2}$ on the earth.

The moon's inhabitants on the ſide next the earth may as eaſily find the longitude of their places as we can find the latitude of ours. For the earth keeping conſtantly, or very nearly ſo, over one meridian of the moon, the eaſt or weſt diſtances of places from that meridian are as eaſily found as we can find our diſtance from the equator by the altitude of our celeſtial poles.

The planet MARS is next in order, being the firſt above the earth's orbit. His diſtance from the ſun is computed to be 125 millions of miles; and by travelling at the rate of 47 thouſand miles every hour, as in the circle ♂, he goes round the ſun in 686 of our days and 23 hours; which is the length of his year, and contains $667\frac{3}{4}$ of his days, every day and night together being 40 minutes longer than with us. His diameter is 4444 miles, and by his diurnal rotation the inhabitants about his equator are carried 556 miles every hour. His quantity of light and heat is equal but to one half of ours; and the ſun appears but half as big to him as to us.

This planet being but a fifth part ſo big as the earth, if any moon attends him, ſhe muſt be very ſmall, and has not yet been diſcovered by our beſt teleſcopes. He is of a fiery red colour, and by his appulſes to ſome of the fixed ſtars ſeems to be encompaſſed by a very groſs atmoſphere. He appears ſometimes gibbous, but never horned; which both ſhews that his orbit includes the earth's within it, and that he ſhines not by his own light.

To Mars, our earth and moon appear like two moons, a bigger and a leſs, changing places with one another, and appearing ſometimes horned, ſometimes half or three quarters illuminated, but never full, nor at moſt above one quarter of a degree from each other, although they are 240 thouſand miles aſunder.

Our earth appears almoſt as big to Mars as Venus does to us, and at Mars it is never ſeen above 48 degrees from the ſun; ſometimes it appears to paſs over the diſk of the ſun, and ſo do Mercury and Venus; but Mercury can never be ſeen from Mars by ſuch eyes as ours, unaſſiſted by proper inſtruments; and Venus will be as ſeldom ſeen as we ſee Mercury. Jupiter and Saturn are as viſible to Mars as to us. His axis is perpendicular to the ecliptic, and his orbit is 2 degrees inclined to it.

JUPITER, the largeſt of all the planets, is ſtill higher in the ſyſtem, being about 426 millions of miles from the ſun; and going at the rate of 25 thouſand miles every hour in his orbit, as in the circle ♃, finiſhes his annual period

Period in eleven of our years 314 days and 12 hours. He is about 1000 times as big as the earth, for his diameter is 81,000 miles; which is more than ten times the diameter of the earth.

Jupiter turns round his axis in 9 hours 56 minutes; ſo that his year contains 10 thouſand 470 days; and the diurnal velocity of his equatoreal parts is greater than the ſwiftneſs with which he moves in his annual orbit; a ſingular circumſtance, as far as we know. By this prodigious quick rotation, his equatoreal inhabitants are carried 25 thouſand 920 miles every hour, (which is 920 miles an hour more than an inhabitant of our earth's equator moves in twenty-four hours), beſides the 25 thouſand above mentioned, which is common to all parts of his ſurface, by his annual motion.

Jupiter is ſurrounded by faint ſubſtances, called *belts*, in which ſo many changes appear, that they are generally thought to be clouds; for ſome of them have been firſt interrupted and broken, and then have vaniſhed entirely. They have ſometimes been obſerved of different breadths, and afterwards have all become nearly of the ſame breadth. Large ſpots have been ſeen in theſe belts; and when a belt vaniſhes, the contiguous ſpots diſappear with it. The broken ends of ſome belts have been generally obſerved to revolve in the ſame time with the ſpots; only thoſe nearer the equator in ſomewhat leſs time than thoſe near the poles, perhaps on account of the ſun's greater heat near the equator, which is parallel to the belts and courſe of the ſpots. Several large ſpots, which appear round at one time, grow oblong by degrees, and then divide into two or three round ſpots. The periodical time of the ſpots near the equator is 9 hours 50 minutes, but of thoſe near the poles 9 hours 56 minutes.

The axis of Jupiter is ſo nearly perpendicular to his orbit, that he has no ſenſible change of ſeaſons; which is a great advantage, and wiſely ordered by the Author of nature. For if the axis of this planet were inclined any conſiderable number of degrees, juſt ſo many degrees round each pole would in their turn be almoſt ſix of our years together in darkneſs. And as each degree of a great circle on Jupiter contains 706 of our miles at a mean rate, it is eaſy to judge what vaſt tracts of land would be rendered uninhabitable by any conſiderable inclination of his axis.

The ſun appears but $\frac{1}{28}$ part ſo big to Jupiter as to us; and his light and heat are in the ſame ſmall proportion, but compenſated by the quick returns thereof, and by four moons (ſome larger and ſome leſs than our earth) which revolve about him; ſo that there is ſcarce any part of this huge planet but what is, during the whole night, enlightened by one or more of theſe moons, except his poles, whence only the fartheſt moons can be ſeen, and where their light is not wanted, becauſe the ſun conſtantly circulates in or near the horizon, and is very probably kept in view of both poles by the refraction of Jupiter's atmoſphere, which, if it be like ours, has certainly refractive power enough for that purpoſe.

The orbits of theſe moons are repreſented in the ſcheme of the ſolar ſyſtem by four ſmall circles marked 1, 2, 3, 4, on Jupiter's orbit ♃; but they are drawn fifty times too large in proportion to it. The firſt moon, or that neareſt to Jupiter, goes round him in 1 day 18 hours and 36 minutes of our time; and is 229 thouſand miles diſtant from his centre; the ſecond performs its revolution in three days 13 hours and 15 minutes, at 364 thouſand miles diſtance; the third in ſeven days three hours and 59 minutes, at the diſtance of 580 thouſand miles; and the fourth, or outermoſt, in 16 days 18 hours and 30 minutes, at the diſtance of one million of miles from his centre. The periods of theſe moons are ſo incommenſurate to one another, that if ever they were all in a right line between Jupiter and the ſun, it will require more than 3,000,000,000,000 years from that time to bring them all into the ſame right line again, as any one will find who reduces all their periods into ſeconds, then multiplies them into one another, and divides the product by 432; which is the higheſt number that will divide the product of all their periodical times, namely, 42,085,303,376,931,994,955,904 ſeconds, without a remainder.

The angles under which the orbits of Jupiter's moons are ſeen from the earth, at its mean diſtance from Jupiter, are as follow: The firſt, 3′ 55″: the ſecond, 6′ 14″; the third, 9′ 58″; and the fourth, 17′ 30″. And their diſtances from Jupiter, meaſured by his ſemidiameters, are thus: The firſt, $5\frac{2}{3}$; the ſecond, 9; the third, $14\frac{23}{60}$; and the fourth, $25\frac{18}{60}$. This planet, ſeen from its neareſt moon, appears 1000 times as large as our moon does to us; waxing and waning in all her monthly ſhapes every $42\frac{1}{2}$ hours.

Jupiter's three neareſt moons fall into his ſhadow, and are eclipſed in every revolution; but the orbit of the fourth moon is ſo much inclined, that it paſſeth by its oppoſition to Jupiter, without falling into his ſhadow, two years in every ſix. By theſe eclipſes, aſtronomers have not only diſcovered that the ſun's light takes up eight minutes of time in coming to us, but they have alſo determined the longitudes of places on this earth with greater certainty and facility than by any other method yet known.

The difference between the equatoreal and polar diameters of Jupiter is 6230 miles; for his equatoreal diameter is to his polar, as 13 to 12. So that his poles are 3115 miles nearer his centre than his equator is.

Jupiter's orbit is 1 degree 20 minutes inclined to the ecliptic. His north node is in the 7th degree of Cancer, and his ſouth node in the 7th degree of Capricorn.

Saturn, the remoteſt of all the planets, is about 780 millions of miles from the ſun; and, travelling at the rate of 18 thouſand miles every hour, as in the circle marked ♄, performs its annual circuit in 29 years 167 days and 5 hours of our time; which makes only one year to that planet. Its diameter is 67,000 miles; and therefore it is near 600 times as big as the earth.

This planet is ſurrounded by a thin broad ring, as an artificial globe is by a horizon, fig. 5. The ring appears double when ſeen through a good teleſcope, and is repreſented by the figure in ſuch an oblique view as it is generally ſeen. It is inclined 30 degrees to the ecliptic, and is about 21 thouſand miles in breadth; which is equal to its diſtance from Saturn on all ſides. There is reaſon

reaſon to believe that the ring turns round its axis, becauſe, when it is almoſt edge-wiſe to us, it appears ſomewhat thicker on one ſide of the planet than on the other; and the thickeſt edge has been ſeen on different ſides at different times. But Saturn having no viſible ſpots on his body, whereby to determine the time of his turning round his axis, the length of his days and nights, and the poſition of his axis, are unknown to us.

To Saturn, the ſun appears only $\frac{1}{90}$th part ſo big as to us; and the light and heat he receives from the ſun are in the ſame proportion to ours. But to compenſate for the ſmall quantity of ſun-light, he has five moons, all going round him on the outſide of his ring, and nearly on the ſame plane with it. The firſt, or neareſt moon to Saturn, goes round him in 1 day 21 hours 19 minutes; and is 140 thouſand miles from his centre: The ſecond, in 2 days 17 hours 40 minutes; at the diſtance of 187 thouſand miles: The third, in 4 days 12 hours 25 minutes, at 263 thouſand miles diſtance: The fourth, in 15 days 22 hours 41 minutes, at the diſtance of 600 thouſand miles: And the fifth or outermoſt, at one million 800 thouſand miles from Saturn's centre, goes round him in 79 days 7 hours 48 minutes. Their orbits, in the ſcheme of the ſolar ſyſtem, are repreſented by the ſmall five circles, marked 1, 2, 3, 4, 5, on Saturn's orbit; but theſe, like the orbits of the other ſatellites, are drawn fifty times too large in proportion to the orbits of their primary planets.

The ſun ſhines almoſt fifteen of our years together on one ſide of Saturn's ring without ſetting, and as long on the other in its turn. So that the ring is viſible to the inhabitants of that planet for almoſt fifteen of our years, and as long inviſible by turns, if its axis has no inclination to its ring: But if the axis of the planet be inclined to the ring, ſuppoſe about 30 degrees, the ring will appear and diſappear once every natural day to all the inhabitants within 30 degrees of the equator, on both ſides, frequently eclipſing the ſun in a Saturnian day. Moreover, if Saturn's axis be ſo inclined to his ring, it is perpendicular to his orbit; and thereby the inconvenience of different ſeaſons to that planet is avoided. For conſidering the length of Saturn's year, which is almoſt equal to thirty of ours, what a dreadful condition muſt the inhabitants of his polar regions be in, if they be half that time deprived of the light and heat of the ſun? which is not their caſe alone, if the axis of the planet be perpendicular to the ring, for then the ring muſt hide the ſun from vaſt tracks of land on each ſide of the equator for 13 or 14 of our years together, on the ſouth ſide and north ſide by turns, as the axis inclines to or from the ſun: The reverſe of which inconvenience is another good preſumptive proof of the inclination of Saturn's axis to its ring, and alſo of his axis being perpendicular to his orbit.

This ring, ſeen from Saturn, appears like a vaſt luminous arch in the heavens, as if it did not belong to the planet. When we ſee the ring moſt open, its ſhadow upon the planet is broadeſt; and from that time the ſhadow grows narrower, as the ring appears to do to us; until, by Saturn's annual motion, the ſun comes to the plane of the ring, or even with its edge; which being then directed towards us, becomes inviſible on account of its thinneſs; as ſhall be explained afterwards. The ring diſappears twice in every annual revolution of Saturn, namely, when he is in the 19th degree both of Piſces and of Virgo. And when Saturn is in the middle between theſe points, or in the 19th degree either of Gemini or of Sagittarius, his ring appears moſt open to us; and then its longeſt diameter is to its ſhorteſt, as 9 to 4.

To ſuch eyes as ours, unaſſiſted by inſtruments, Jupiter is the only planet that can be ſeen from Saturn, and Saturn the only planet that can be ſeen from Jupiter. So that the inhabitants of theſe two planets muſt either ſee much farther than we do, or have equally good inſtruments to carry their ſight to remote objects, if they know that there is ſuch a body as our earth in the univerſe: For the earth is no bigger, ſeen from Jupiter, than his moons are ſeen from the earth; and if his large body had not firſt attracted our ſight, and prompted our curioſity to view him with the teleſcope, we ſhould never have known any thing of his moons; unleſs by chance we had directed the teleſcope toward that ſmall part of the heavens where they were at the time of obſervation. And the like is true of the moons of Saturn.

The orbit of Saturn is $2\frac{1}{2}$ degrees inclined to the ecliptic, or orbit of our earth, and interſects it in the 21ſt degree of Cancer and of Capricorn; ſo that Saturn's nodes are only 14 degrees from Jupiter's.

The quantity of light, afforded by the ſun to Jupiter, being but $\frac{1}{28}$th part, and to Saturn only $\frac{1}{90}$th part, of what we enjoy, may, at firſt thought, induce us to believe that theſe two planets are entirely unfit for rational beings to dwell upon. But, that their light is not ſo weak as we imagine, is evident from their brightneſs in the night-time; and alſo from this remarkable phenomenon, that when the ſun is ſo much eclipſed to us, as to have only the 40th part of his diſk left uncovered by the moon, the decreaſe of light is not very ſenſible; and juſt at the end of darkneſs in total eclipſes, when his weſtern limb begins to be viſible, and ſeems no bigger than a bit of fine ſilver wire, every one is ſurpriſed at the brightneſs wherewith that ſmall part of him ſhines. The moon, when full, affords travellers light enough to keep them from miſtaking their way; and yet, according to Dr Smith, it is equal to no more than a 90 thouſandth part of the light of the ſun: That is, the ſun's light is 90 thouſand times as ſtrong as the light of the moon when full. Conſequently, the ſun gives a thouſand times as much light to Saturn as the full moon does to us; and above three thouſand times as much to Jupiter. So that theſe two planets, even without any moons, would be much more enlightened than we at firſt imagine; and by having ſo many, they may be very comfortable places of reſidence. Their heat, ſo far as it depends on the force of the ſun's rays, is certainly much leſs than ours; to which no doubt the bodies of their inhabitants are as well adapted as ours are to the ſeaſons we enjoy. And if we conſider, that Jupiter never has any winter, even at his poles, which probably is alſo the caſe with Saturn, the cold cannot be ſo intenſe on theſe two planets as is generally imagined. Beſides, there may be ſomething in their nature or ſoil much warmer than

than in that of our earth: And we find that all our heat depends not on the rays of the ſun; for if it did, we ſhould always have the ſame months equally hot or cold at their annual returns. But it is far otherwiſe, for February is ſometimes warmer than May; which muſt be owing to vapours and exhalations from the earth.

Every perſon who looks upon, and compares the ſyſtems of moons together, which belong to Jupiter and Saturn, muſt be amazed at the vaſt magnitude of theſe two planets, and the noble attendance they have in reſpect of our little earth; and can never bring himſelf to think, that an infinitely wiſe Creator ſhould diſpoſe of all his animals and vegetables here, leaving the other planets bare and deſtitute of rational creatures. To ſuppoſe that he had any view to our benefit, in creating theſe moons, and giving them their motions round Jupiter and Saturn; to imagine that he intended theſe vaſt bodies for any advantage to us, when he well knew that they could never be ſeen but by a few aſtronomers peeping through teleſcopes; and that he gave to the planets regular returns of days and nights, and different ſeaſons to all where they would be convenient; but of no manner of ſervice to us, except only what immediately regards our own planet the earth; to imagine that he did all this on our account, would be charging him impiouſly with having done much in vain; and as abſurd, as to imagine that he has created a little ſun and a planetary ſyſtem within the ſhell of our earth, and intended them for our uſe. Theſe conſiderations amount to little leſs than a poſitive proof, that all the planets are inhabited: For if they are not, why all this care in furniſhing them with ſo many moons, to ſupply thoſe with light which are at the greater diſtances from the ſun? Do we not ſee, that the farther a planet is from the ſun, the greater apparatus it has for that purpoſe? ſave only Mars, which being but a ſmall planet, may have moons too ſmall to be ſeen by us. We know that the earth goes round the ſun, and turns round its own axis, to produce the viciſſitudes of ſummer and winter by the former, and of day and night by the latter motion, for the benefit of its inhabitants. May we not then fairly conclude, by parity of reaſon, that the end and deſign of all the other planets is the ſame? and is not this agreeable to the beautiful harmony which exiſts throughout the univerſe?

In fig. 2. we have a view of the proportional breadth of the ſun's face or diſk, as ſeen from the different planets. The ſun is repreſented, N° 1, as ſeen from Mercury; N° 2, as ſeen from Venus; N° 3, as ſeen from the earth; N° 4, as ſeen from Mars; N° 5, as ſeen from Jupiter; and N° 6, as ſeen from Saturn.

Let the circle *B*, (fig. 3.) be the ſun as ſeen from any planet, at a given diſtance; to another planet, at double that diſtance, the ſun will appear juſt of half that breadth, as *A*, which contains only one fourth part of the area, or ſurface of *B*. For all circles, as well as ſquare ſurfaces, are to one another as the ſquares of their diameters. Thus, (fig. 4.) the ſquare *A* is juſt half as broad as the ſquare *B*; and yet it is plain to ſight, that *B* contains four times as much ſurface as *A*. Hence, by comparing the diameters of the above circles (fig. 2.) together, it will be found, that, in round numbers, the ſun appears 7 times larger to Mercury than to us, 90 times larger to us than to Saturn, and 630 times as large to Mercury as to Saturn.

In fig. 5. we have a view of the bulks of the planets in proportion to each other, and to a ſuppoſed globe of two feet diameter for the ſun. The earth is 27 times as big as Mercury, very little bigger than Venus, five times as big as Mars; but Jupiter is 1049 times as big as the earth; Saturn 586 times as big, excluſive of his ring; and the ſun is 877 thouſand 650 times as big as the earth. If the planets in this figure were ſet at their due diſtances from a ſun of two feet diameter, according to their proportional bulks, as in our ſyſtem, Mercury would be 28 yards from the ſun's centre; Venus 51 yards 1 foot; the earth 70 yards 2 feet; Mars 107 yards 2 feet; Jupiter 370 yards 2 feet; and Saturn 760 yards two feet; the comet of the year 1680, at its greateſt diſtance, 10 thouſand 760 yards. In this proportion, the moon's diſtance from the centre of the earth would be only $7\frac{1}{2}$ inches.

To aſſiſt the imagination in forming an idea of the vaſt diſtances of the ſun, planets, and ſtars, let us ſuppoſe, that a body projected from the ſun ſhould continue to fly with the ſwiftneſs of a cannon-ball, *i. e.* 480 miles every hour; this body would reach the orbit of Mercury, in 7 years 221 days; of Venus, in 14 years 8 days; of the earth, in 19 years 91 days; of Mars, in 29 years 85 days; of Jupiter, in 100 years 280 days; of Saturn, in 184 years 240 days; to the comet of 1680, at its greateſt diſtance from the ſun, in 2660 years; and to the neareſt fixed ſtars, in about 7 million 600 thouſand years.

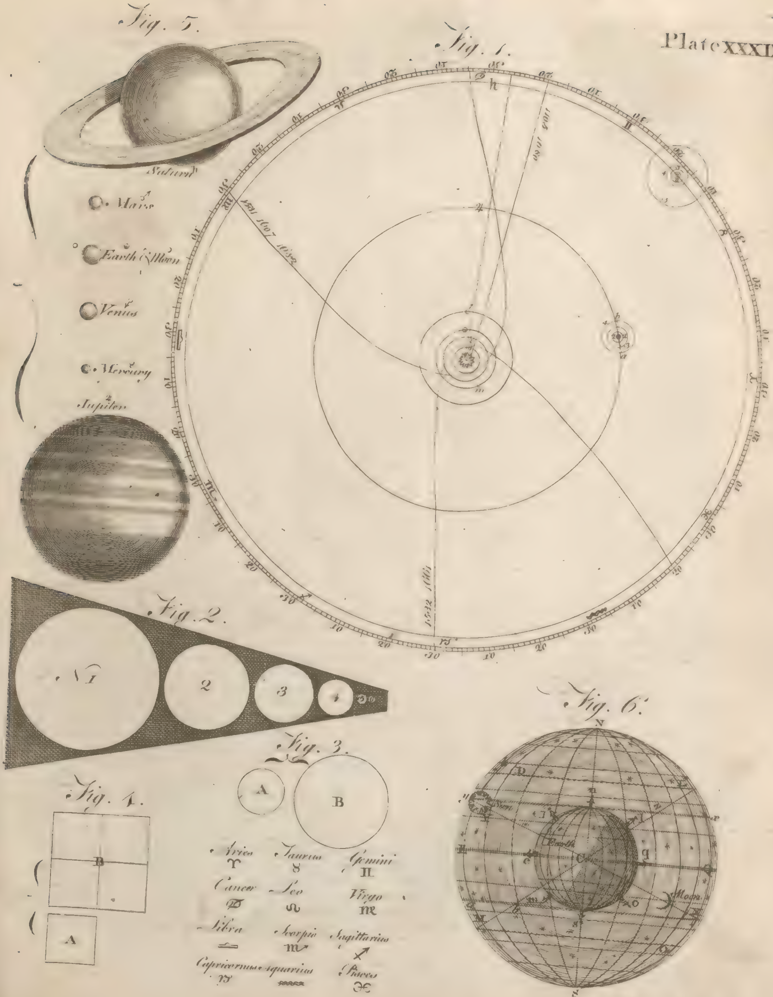
As the earth is not the centre of the orbits in which the planets move, they come nearer to it and go farther from it, and at different times; on which account they appear bigger and leſs by turns. Hence, the apparent magnitudes of the planets are not always a certain rule to know them by.

Under fig. 3. are the names and characters of the twelves ſigns of the zodiac, which the reader ſhould be perfectly well acquainted with, ſo as to know the characters without ſeeing the names. Every ſign contains 30 degrees, as in the circle bounding the ſolar ſyſtem; to which the characters of the ſigns are ſet in their proper places.

The Comets are ſolid opaque bodies, with long tranſparent trains or tails, iſſuing from that ſide which is turned away from the ſun. They move about the ſun in very excentric ellipſes; and are of a much greater denſity than the earth; for ſome of them are heated in every period to ſuch a degree, as would vitrify or diſſipate any ſubſtance known to us. Sir Iſaac Newton computed the heat of the comet which appeared in the year 1680, when neareſt the ſun, to be 2000 times hotter than red-hot iron; and that, being thus heated, it muſt retain its heat until it comes round again, although its period ſhould be more than twenty thouſand years; and it is computed to be only 575.

Part of the paths of three comets are delineated in the ſcheme of the ſolar ſyſtem, and the years marked in which they made their appearance. It is believed that

Plate XXXIX.



Aries ♈	Taurus ♉	Gemini ♊
Cancer ♋	Leo ♌	Virgo ♍
Libra ♎	Scorpio ♏	Sagittarius ♐
Capricornus ♑	Aquarius ♒	Pisces ♓

A. Bell Sculp^t.

that there are at leaſt 21 comets belonging to our ſyſtem, moving in all ſorts of directions; and all thoſe which have been obſerved, have moved through the etherial regions and the orbits of the planets without ſuffering the leaſt ſenſible reſiſtance in their motions; which plainly proves that the planets do not move in ſolid orbs. Of all the comets, the periods of the above mentioned three only are known with any degree of certainty. The firſt of theſe comets appeared in the years 1531, 1607, and 1682; was expected to appear again in the year 1758, and every 75th year afterwards. The ſecond of them appeared in 1532 and 1661, and may be expected to return in 1789, and every 129th year afterwards. The third, having laſt appeared in 1680, and its period being no leſs than 575 years, cannot return until the year 2225. This comet, at its greateſt diſtance, is about 11 thouſand two hundred millions of miles from the ſun; and at its leaſt diſtance from the ſun's centre, which is 490,000 miles, is within leſs than a third part of the ſun's ſemidiameter from his ſurface. In that part of its orbit which is neareſt the ſun, it flies with the amazing ſwiftneſs of 880,000 miles in an hour; and the ſun, as ſeen from it, appears an hundred degrees in breadth, conſequently 40 thouſand times as large as he appears to us. The aſtoniſhing length that this comet runs out into empty ſpace, ſuggeſts to our minds an idea of the vaſt diſtance between the ſun and the neareſt fixed ſtars; of of whoſe attractions all the comets muſt keep clear to return periodically, and go round the ſun; and it ſhews us alſo, that the neareſt ſtars, which are probably thoſe that ſeem the largeſt, are as big as our ſun, and of the ſame nature with him; otherwiſe they could not appear ſo large and bright to us as they do at ſuch an immenſe diſtance.

The extreme heat, the denſe atmoſphere, the groſs vapours, the chaotic ſtate of the comets, ſeem at firſt ſight to indicate them altogether unfit for the purpoſes of animal life, and a moſt miſerable habitation for rational beings; and therefore ſome are of opinion that they are ſo many hells for tomenting the damned with perpetual viciſſitudes of heat and cold. But when we conſider, on the other hand, the infinite power and goodneſs of the Deity, the latter inclining, and the former enabling him to make creatures ſuited to all ſtates and circumſtances; that matter exiſts only for the ſake of intelligent beings; and that where-ever we find it, we always find it pregnant with life, or neceſſarily ſubſervient thereto; the numberleſs ſpecies, the aſtoniſhing diverſity of animals in earth, air, water, and even on other animals; every blade of graſs, every leaf, every fluid ſwarming with life; and every one of theſe enjoying ſuch gratifications as the nature and ſtate of each requires: When we reflect moreover, that ſome centuries ago, till experience undeceived us, a great part of the earth was judged uninhabitable, the torrid zone by reaſon of exceſſive heat, and the frigid zones becauſe of their intolerable cold; it ſeems highly probable, that ſuch numerous and large maſſes of durable matter as the comets are, however unlike they be to our earth, are not deſtitute of beings capable of contemplating with wonder, and acknowledging with gratitude, the wiſdom, ſymmetry, and beauty of the creation; which is more plainly to be obſerved in their extenſive tour through the heavens, than in our more confined circuit. If farther conjecture is permitted, may we not ſuppoſe them inſtrumental in recruiting the expanded fuel of the ſun, and ſupplying the exhauſted moiſture of the planets? However difficult it may be, circumſtanced as we are, to find out their particular deſtination, this is an undoubted truth, that where-ever the Deity exerts his power, there he alſo manifeſts his wiſdom and goodneſs.

The ſolar ſyſtem here deſcribed is not a late invention, for it was known and taught by the wiſe Samian philoſopher Pythagoras, and others among the ancients; but in latter times was loſt, till the 15th century, when it was again reſtored by the famous Poliſh philoſopher, Nicholas Copernicus, who was born at Thorn in the year 1473. In this he was followed by the greateſt mathematicians and philoſophers that have ſince lived; as Kepler, Galileo, Deſcartes, Gaſſendus, and Sir Iſaac Newton; the laſt of whom has eſtabliſhed this ſyſtem on ſuch a foundation of mathematical and phyſical demonſtration, as can never be ſhaken.

In the Ptolemean ſyſtem, the earth was ſuppoſed to be fixed in th ecentre of the univerſe; and that the Moon, Mercury, Venus, the Sun, Mars, Jupiter, and Saturn, moved round the earth: Above the planets this hypotheſis placed the firmament of ſtars, and then the two cryſtalline ſpheres; all which were included in and received motion from the *primum mobile*, which conſtantly revolved about the earth in 24 hours from eaſt to weſt. But as this rude ſcheme was found incapable to ſtand the teſt of art and obſervation, it was ſoon rejected by all true philoſophers.

The Tychonic ſyſtem ſucceeded the Ptolemean, but was never ſo generally received. In this the earth was ſuppoſed to ſtand ſtill in the centre of the univerſe or firmament of ſtars, and the ſun to revolve about it every 24 hours; the planets, Mercury, Venus, Mars, Jupiter, and Saturn, going round the ſun in the times already mentioned. But ſome of Tycho's diſciples ſuppoſed the earth to have a diurnal motion round its axis, and the ſun, with all the above planets, to go round the earth in a year; the planets moving round the ſun in the foreſaid times. This hypotheſis, being partly true, and partly falſe, was embraced by few; and ſoon gave way to the only true and rational ſcheme, reſtored by Copernicus, and demonſtrated by Sir Iſaac Newton.

CHAP. III. *The Phenomena of the Heavens as ſeen from different Parts of the Earth.*

WE are kept to the earth's ſurface on all ſides by the power of its central attraction; which, laying hold of all bodies according to their denſities or quantities of matter, without regard to their bulks, conſtitutes what we call their *weight*. And having the ſky over our heads, go where we will, and our feet towards the centre of the earth, we call it *up* over our heads, and *down* under our feet: Although the ſame right line which is *down* to us, if continued through, and beyond the oppoſite ſide of the earth,

earth, would be *up* to the inhabitants on the oppofite fide. For, the inhabitants n, i, e, m, s, o, q, l, (Plate XXXIX. fig. 6.) ftand with their feet towards the earth's centre *C*; and have the fame figure of fky, *N*, *l*, *E*, *M*, *S*, *O*, *♎*, *L* over their heads. Therefore the point *S* is as directly upward to the inhabitant (s) on the fouth pole, as *N* is to the inhabitant n on the north pole; fo is *E* to the inhabitant e, fuppofed to be on the north end of Peru; and *♎* to the oppofite inhabitant q on the middle of the ifland of Sumatra. Each of thefe obfervers is furprifed that his oppofite or antipode can ftand with his head hanging downwards. But let either go to the other, and he will tell him that he ftood as upright and firm upon the place where he was, as he now ftands where he is. To all thefe obfervers, the fun, moon, and ftars, feem to turn round the points *N* and *S*, as the poles of the fixed axis *NCS*; becaufe the earth does really turn round the mathematical line n*C*s as round an axis, of which n is the north pole, and s the fouth pole. The inhabitant *U* (Plate XL. fig. 1.) affirms that he is on the uppermoft fide of the earth, and wonders how another at *L* can ftand on the undermoft fide with his head hanging downwards. But *U*, in the mean time, forgets that in twelve hours time he will be carried half round with the earth, and then be in the very fituation that *L* now is, although as far from him as before. And yet, when *U* comes there, he will find no difference as to his manner of ftanding; only he will fee the oppofite half of the heavens, and imagine the heavens to have gone half round the earth.

When we fee a globe hung up in a room, we cannot help imagining it to have an upper and an under fide, and immediately form a like idea of the earth; from whence we conclude, that it is as impoffible for people to ftand on the under fide of the earth, as for pebbles to lie on the under fide of a common globe, which inftantly fall down from it to the ground; and well they may, becaufe the attraction of the earth, being greater than the attraction of the globe, pulls them away. Juft fo would be the cafe with our earth, if it were placed near a globe much bigger than itfelf, fuch as Jupiter; for then it would really have an upper and an under fide, with refpect to that large globe; which, by its attraction, would pull away every thing from the fide of the earth next to it; and only thofe on the top of the oppofite or upper fide could remain upon it. But there is no larger globe near enough our earth to overcome its central attraction; and therefore it has no fuch thing as an upper and an under fide; for all bodies, on or near its furface, even to the moon, gravitate towards its centre.

The earth's bulk is but a point, as that at *C*, compared to the heavens; and therefore every inhabitant upon it, let him be where he will, as at n, e, m, s, &c. fees half of the heavens. The inhabitant n, on the north pole of the earth, conftantly fees the hemifphere *EN♎*; and having the north pole *N* of the heavens juft over his head, his horizon coincides with the celeftial equator *EC♎*. Therefore, all the ftars in the northern hemifphere *EN♎*, between the equator and north pole, appear to turn round the line *NC*, moving parallel to the horizon. The equatoreal ftars keep in the horizon, and all thofe in the fouthern hemifphere *ES♎* are invifible. The like phenomena are feen by the obferver (s) on the fouth pole, with refpect to the hemifphere *ES♎*; and to him the oppofite hemifphere is always invifible. Hence, under either pole, only half of the heavens is feen; for thofe parts which are once vifible never fet, and thofe which are once invifible never rife. But the ecliptic *♈CX*, or orbit which the fun appears to defcribe once a year by the earth's annual motion, has the half *♈C* conftantly above the horizon *EC♎* of the north pole n; and the other half *CX* always below it. Therefore, whilft the fun defcribes the northern half *♈C* of the ecliptic, he neither fets to the north pole, nor rifes to the fouth; and whilft he defcribes the fouthern half *CX*, he neither fets to the fouth pole nor rifes to the north. The fame things are true with refpect to the moon; only with this difference, that as the fun defcribes the ecliptic but once a year, he is for half that time vifible to each pole in its turn, and as long invifible; but as the moon goes round the ecliptic in 27 days 8 hours, fhe is only vifible for 13 days 16 hours, and as long invifible to each pole by turns. All the planets likewife rife and fet to the poles, becaufe their orbits are cut obliquely in halves by the horizon of the poles. When the fun (in his apparent way from *X*) arrives at *C*, which is on the 20th of March, he is juft rifing to an obferver n on the north pole, and fetting to another at s on the fouth pole. From *C* he rifes higher and higher in every apparent diurnal revolution, till he comes to the higheft point of the ecliptic *y*, on the 21ft of June, and then he is at his greateft altitude, which is $23\frac{1}{2}$ degrees, or the arc *Ey*, equal to his greateft north declination; and from thence he feems to defcend gradually in every apparent circumvolution, till he fets at *C* on the 23d of September; and then he goes to exhibit the like appearances at the fouth pole for the other half of the year. Hence, the fun's apparent motion round the earth is not in parallel circles, but in fpirals; fuch as might be reprefented by a thread wound round a globe from tropic to tropic; the fpirals being at fome diftance from one another about the equator, and gradually nearer to each other as they approach toward the tropics.

If the obferver be any where on the terreftrial equator e*C*q, as fuppofe at e, he is in the plane of the celeftial equator; or under the equinoxial *EC♎*; and the axis of the earth n*C*s is coincident with the plane of his horizon, extended out to *N* and *S*, the north and fouth poles of the heavens. As the earth turns round the line *NCS*, the whole heavens *MOLl* feem to turn round the fame line, but the contrary way. It is plain that this obferver has the celeftial poles conftantly in his horizon; and that his horizon cuts the diurnal paths of all the celeftial bodies perpendicularly and in halves. Therefore the fun, planets and ftars, rife every day, and afcend perpendicularly above the horizon for fix hours; and, paffing over the meridian, defcend in the fame manner for the fix following hours; then fet in the horizon, and continue twelve hours below it. Confequently at the equator the days and nights are equally long throughout the year. When the obferver is in the fituation e, he fees the hemifphere *SEN*; but in twelve hours after, he

he is carried half round the earth's axis to q, and then the hemisphere *SQN* becomes visible to him; and *SEN* disappears. Thus we find, that to an observer at either of the poles, one half of the sky is always visible, and the other half never seen; but to an observer on the equator, the whole sky is seen every 24 hours.

The figure here referred to, represents a celestial globe of glass, having a terrestial globe within it; after the manner of the glass-sphere invented by Dr Long, Lowndes's professor of astronomy in Cambridge.

If a globe be held sidewise to the eye, at some distance, and so that neither of its poles can be seen, the equator *ECQ*, and all circles parallel to it, as *DL*, *yzx*, *abX*, *MO*, &c. will appear to be straight lines, as projected in this figure; which is requisite to be mentioned here, because we shall have occasion to call them circles in the following articles of this chapter.

Let us now suppose that the observer has gone from the equator e towards the north pole n, and that he stops at i, from which place he then sees the hemisphere *MEINL*; his horizon *MCL* having shifted as many degrees from the celestial poles *N* and *S*, as he has travelled from under the equinoctial *E*. And as the heavens seem constantly to turn round the line *NCS* as an axis, all those stars which are not so many degrees from the north pole *N* as the observer is from the equinoctial, namely, the stars north of the dotted parallel *DL*, never set below the horizon; and those which are south of the dotted parallel *MO* never rise above it. Hence the former of these two parallel circles is called *the circle of perpetual apparition*, and the latter *the circle of perpetual occultation*; but all the stars between these two circles rise and set every day. Let us imagine many circles to be drawn between these two, and parallel to them; those which are on the north side of the equinoctial will be unequally cut by the horizon *MCL*, having larger portions above the horizon than below it; and the more so, as they are nearer to the circle of perpetual apparition; but the reverse happens to those on the south side of the equinoctial, whilst the equinoctial is divided in two equal parts by the horizon. Hence, by the apparent turning of the heavens, the northern stars describe greater arcs or portions of circles above the horizon than below it; and the greater, as they are farther from the equinoctial towards the circle of perpetual apparition; whilst the contrary happens to all stars south of the equinoctial; but those upon it describe equal arcs both above and below the horizon, and therefore they are just as long above as below it.

An observer on the equator has no circle of perpetual apparition or occultation, because all the stars, together with the sun and moon, rise and set to him every day. But, as a bare view of the figure is sufficient to shew that these two circles *DL* and *MO* are just as far from the poles *N* and *S* as the observer at i (or one opposite to him at o) is from the equator *ECQ*, it is plain, that if an observer begins to travel from the equator towards either pole, his circle of perpetual apparition rises from that pole as from a point, and his circle of perpetual occultation from the other. As the observer advances toward the nearer pole, these two circles enlarge their diameters, and come nearer one another, until he comes to the pole; and then they meet and coincide in the equinoctial. On different sides of the equator, to observers at equal distances from it, the circle of perpetual apparition to one is the circle of perpetual occultation to the other.

Because the stars never vary their distances from the equinoctial, so as to be sensible in an age, the lengths of their diurnal and nocturnal arcs are always the same to the same places on the earth. But as the earth goes round the sun every year in the ecliptic, one half of which is on the north side of the equinoctial, and the other half on its south side, the sun appears to change his place every day, so as to go once round the circle *YCX* every year. Therefore whilst the sun appears to advance northward, from having described the parallel ab*X* touching the ecliptic in *X*, the days continually lengthen and the nights shorten, until he comes to *y* and describes the parallel *yzx*, when the days are at the longest and the nights at the shortest; for then, as the sun goes no farther northward, the greatest portion that is possible of the diurnal arc *yz* is above the horizon of the inhabitant *i*, and the smallest portion *zx* below it. As the sun declines southward from *y*, he describes smaller diurnal and greater nocturnal arcs, or portions of circles every day; which causeth the days to shorten and nights to lengthen, until he arrives again at the parallel *abX*; which having only the small part *ab* above the horizon *MCL*, and the great part *bX* below it, the days are at the shortest and the nights at the longest; because the sun recedes no farther south, but returns northward as before. It is easy to see that the sun must be in the equinoctial *ECQ* twice every year, and then the days and nights are equally long; that is, 12 hours each. These hints serve at present to give an idea of some of the appearances resulting from the motions of the earth; which will be more particularly described in the tenth chapter.

To an observer at either pole, the horizon and equinoctial are coincident; and the sun and stars seem to move parallel to the horizon; therefore, such an observer is said to have a parallel position of the sphere. To an observer any where between either pole and equator, the parallels described by the sun and stars are cut obliquely by the horizon, and therefore he is said to have an oblique position of the sphere. To an observer any where on the equator, the parallels of motion, described by the sun and stars, are cut perpendicularly, or at right angles, by the horizon; and therefore he is said to have a right position of the sphere. And these three are all the different ways that the sphere can be posited to all people on the earth.

Chap. IV. *The Phenomena of the Heavens as seen from different parts of the Solar System.*

So vastly great is the distance of the starry heavens, that if viewed from any part of the solar system, or even many

many millions of miles beyond it, its appearance would be the very ſame to us. The ſun and ſtars would all ſeem to be fixed on one concave ſurface, of which the ſpectator's eye would be the centre. But the planets being much nearer than the ſtars, their appearances will vary conſiderably with the place from which they are viewed.

If the ſpectator is at reſt without their orbits, the planets will ſeem to be at the ſame diſtance as the ſtars, but continually changing their places with reſpect to the ſtars and to one another, aſſuming various phaſes of increaſe and decreaſe like the moon; and, notwithſtanding their regular motions about the ſun, will ſometimes appear to move quicker, ſometimes ſlower, be as often to the weſt as to the eaſt of the ſun, and at their greateſt diſtances ſeem quite ſtationary. The duration, extent, and diſtance of thoſe points in the heavens where theſe digreſſions begin and end, would be more or leſs, according to the reſpective diſtances of the ſeveral planets from the ſun; but in the ſame planet they would continue invariably the ſame at all times; like pendulums of unequal lengths oſcillating together, the ſhorter move quick and go over a ſmall place, the longer move ſlow and go over a large ſpace. If the obſerver is at reſt within the orbits of the planets, but not near the common centre, their apparent motions will be irregular, but leſs ſo than in the former caſe. Each of the ſeveral planets will appear larger and leſs by turns, as they approach nearer or recede farther from the obſerver, the neareſt varying moſt in their ſize. They will alſo move quicker or ſlower with regard to their fixed ſtars, but will never be retrograde or ſtationary.

If an obſerver in motion views the heavens, the ſame apparent irregularities will be obſerved, but with ſome variation reſulting from its own motion. If he is on a planet which has a rotation on its axis, not being ſenſible of his own motion, he will imagine the whole heavens, ſun, planets, and ſtars, to revolve about him in the ſame time that his planet turns round, but the contrary way, and will not be eaſily convinced of the deception. If his planet moves round the ſun, the ſame irregularities and aſpects as above mentioned will appear in the motions of the other planets; and the ſun will ſeem to move among the fixed ſtars or ſigns, directly oppoſite to thoſe in which his planet moves, changing its place every day as he does. In a word, whether our obſerver be in motion or at reſt, whether within or without the orbits of the planets, their motions will ſeem irregular, intricate, and perplexed, unleſs he is in the centre of the ſyſtem; and from thence the moſt beautiful order and harmony will be ſeen by him.

The ſun being the centre of all the planets motions, the only place from which their motions could be truly ſeen is the ſun's centre; where the obſerver, being ſuppoſed not to turn round with the ſun, (which, in this caſe, we muſt imagine to be a tranſparent body), would ſee all the ſtars at reſt, and ſeemingly equidiſtant from him. To ſuch an obſerver, the planets would appear to move among the fixed ſtars, in a ſimple, regular, and uniform manner; only, that as in equal times they deſcribe equal areas, they would deſcribe ſpaces ſomewhat unequal, becauſe they move in elliptic orbits. Their motions would alſo appear to be what they are in fact, the ſame way round the heavens, in paths which croſs at ſmall angles in different parts of the heavens, and then ſeparate a little from one another: ſo that if the ſolar aſtronomer ſhould make the path or orbit of any one planet a ſtandard, and conſider it as having no obliquity, he would judge the paths of all the reſt to be inclined to it, each planet having one half of its path on one ſide, and the other half on the oppoſite ſide of the ſtandard path or orbit. And if he ſhould ever ſee all the planets ſtart from a conjunction with each other, Mercury would move ſo much faſter than Venus, as to overtake her again (though not in the ſame point of the heavens) in a quantity of time almoſt equal to 145 of our days and nights, or, as we commonly call them, *natural days*, which include both the days and nights; Venus would move ſo much faſter than the earth, as to overtake it again in 585 natural days; the earth ſo much faſter than Mars, as to overtake him again in 778 ſuch days; Mars ſo much faſter than Jupiter, as to overtake him again in 817 ſuch days; and Jupiter ſo much faſter than Saturn, as to overtake him again in 7236 days, all of our time.

But as our ſolar aſtronomer could have no idea of meaſuring the courſes of the planets by our days, he would probably take the period of Mercury, which is the quickeſt moving planet, for a meaſure to compare the periods of the others by. As all the ſtars would appear quieſcent to him, he would never think that they had any dependence upon the ſun; but would naturally imagine that the planets have, becauſe they move round the ſun. And it is by no means improbable, that he would conclude thoſe planets whoſe periods are quickeſt, to move in orbits proportionably leſs than thoſe do which make ſlower circuits. But being deſtitute of a method for finding their parallaxes, or, more properly ſpeaking, as they could have no parallax to him, he could never know any thing of their real diſtances or magnitudes. Their relative diſtances he might perhaps gueſs at by their periods, and from thence infer ſomething of truth concerning their relative bulks, by comparing their apparent bulks with one another. For example, Jupiter appearing bigger to him than Mars, he would conclude it to be much bigger in fact; becauſe it appears ſo, and muſt be farther from him on account of its longer period. Mercury and the earth would ſeem much of the ſame bulk; but, by comparing its period with the earth's, he would conclude that the earth is much farther from him than Mercury, and conſequently that it muſt be really larger, though apparently of the ſame bulk; and ſo of the reſt. And as each planet would appear ſomewhat larger in one part of its orbit than in the oppoſite, and to move quickeſt when it ſeems biggeſt, the obſerver would be at no loſs to determine that all the planets move in orbits, of which the ſun is not preciſely in the centre.

The apparent magnitudes of the planets continually change as ſeen from the earth; which demonſtrates that they approach nearer to it, and recede farther from it by turns. From theſe phenomena, and their apparent motions among the ſtars, they ſeem to deſcribe looped curves which never return into themſelves, Venus's path excepted.

excepted. And if we were to trace out all their apparent paths, and put the figures of them together in one diagram, they would appear so anomalous and confused, that no man in his senses could believe them to be representations of their real paths; but would immediately conclude, that such apparent irregularities must be owing to some optic illusions: And after a good deal of inquiry, he might perhaps be at a loss to find out the true cause of these inequalities; especially if he were one of those who would rather, with the greatest justice, charge frail man with ignorance, than the Almighty with being the author of such confusion.

Dr Long, in his first volume of Astronomy, has given us figures of the apparent paths of all the planets separately from Cassini; from them Mr Ferguson first thought of attempting to trace some of them by an orrery, that shews the motions of the sun, Mercury, Venus, the earth, and moon, according to the Copernican system. Having taken off the sun, Mercury, and Venus, he put black lead pencils in their places, with the points turned upward, and fixed a circular sheet of pasteboard so that the earth kept constantly under its centre in going round the sun, and the pasteboard kept its parallelism. Then, pressing gently with one hand upon the pasteboard to make it touch the three pencils, with the other hand he turned the winch that moves the whole machinery: and as the earth together with the pencils in the places of Mercury and Venus had their proper motions round the sun's pencils, which kept at rest in the centre of the machine, all the three pencils described a diagram, from which fig. 2. of Plate XL. is truly copied in a smaller size. As the earth moved round the sun, the sun's pencil described the dotted circle of months, whilst Mercury's pencil drew the curve with the greatest number of loops, and Venus's that with the fewest. In their inferior conjunctions they come as much nearer the earth, or within the circle of the sun's apparent motion round the heavens, as they go beyond it in their superior conjunctions. On each side of the loops they appear stationary; in that part of each loop next the earth retrograde; and in all the rest of their paths direct.

If Cassini's figures of the paths of the sun, Mercury, and Venus, were put together, the figure as above traced out would be exactly like them. It represents the sun's apparent motion round the ecliptic, which is the same every year; Mercury's motion for seven years, and Venus's for eight; in which time Mercury's path makes 23 loops, crossing itself so many times, and Venus's only five. In eight years, Venus falls so nearly into the same apparent path again, as to deviate very little from it in some ages; but in what number of years Mercury and the rest of the planets would describe the same visible paths over again, it is hard to determine. Having finished the above figure of the paths of Mercury and Venus, he put the ecliptic round them as in the Doctor's book, and added the dotted lines from the earth to the ecliptic for shewing Mercury's apparent or geocentric motion therein for one year; in which time his path makes three loops, and goes on a little farther; which shews that he has three inferior, and as many superior conjunctions with the sun in that time; and also that he is six times stationary, and thrice retrograde. Let us now trace his motion for one year in the figure.

In Plate XL. fig. 2. suppose Mercury to be setting out from *A* towards *B*, (between the earth and left hand corner of the Plate), and as seen from the earth, his motion will then be direct, or according to the order of the signs. But when he comes to *B*, he appears to stand still in the 23d degree of ♍ at *F*, as shewn by the line *BF*. Whilst he goes from *B* to *C*, the line *BF*, supposed to move with him, goes backward from *F* to *E*, or contrary to the order of signs; and when he is at *C*, he appears stationary at *E*, having gone back $11\frac{1}{2}$ degrees. Now, suppose him stationary on the first of January at *C*, on the 10th thereof he will appear in the heavens as at 20, near *F*; on the 20th, he will be seen as at *G*; on the 31st, at *H*; on the 10th of February, at *I*; on the 20th, at *K*; and on the 28th, at *L*; as the dotted lines shew, which are drawn through every tenth day's motion in his looped path, and continued to the ecliptic. On the 10th of March, he appears at *M*; on the 20th, at *N*; and on the 31st, at *O*. On the 10th of April, he appears stationary at *P*; on the 20th, he seems to have gone back again to *O*; and on the 30th, he appears stationary at ♌, having gone back $11\frac{1}{2}$ degrees. Thus Mercury seems to go forward 4 signs 11 degrees, or 131 degrees, and to go back only 11 or 12 degrees, at a mean rate. From the 30th of April to the 10th of May, he seems to move from ♌ to *R*; and on the 20th, he is seen at *S*, going forward in the same manner again, according to the order of letters; and backward when they go back; which it is needless to explain any farther, as the reader can trace him out so easily through the rest of the year. The same appearances happen in Venus's motion; but as she moves slower than Mercury, there are longer intervals of time between them.

CHAP. V. *The physical Causes of the Motions of the Planets. The Excentricities of their Orbits. The Times in which the Action of Gravity alone would bring them to the Sun.*

FROM the uniform projectile motion of bodies in straight lines, and the universal power of attraction which draws them off from these lines, the curvilineal motions of all the planets arise. In Plate XL. fig. 3. if the body *A* be projected along the right line *ABX*, in open space, where it meets with no resistance, and is not drawn aside by any other power, it will for ever go on with the same velocity, and in the same direction. For the force which moves it from *A* to *B* in any given time, will carry it from *B* to *X* in as much more time, and so on, there being nothing to obstruct or alter its motion. But if when this projectile force has carried it, suppose to *B*, the body *S* begins to attract it, with a power duly adjusted, and perpendicular to its motion at *B*, it will then be drawn from the straight line *ABX*, and forced to revolve about *S* in the circle *BYTU*. When the body *A* comes to *U*, or any other part of its orbit, if the small body *u*, within the sphere of

of U's attraction, be projected as in the right line Z, with a force perpendicular to the attraction of U, then u will go round U in the orbit W, and accompany it in its whole course round the body S. Here S may represent the sun, U the earth, and u the moon.

If a planet at B gravitates, or is attracted toward the sun so as to fall from B to y in the time that the projectile force would have carried it from B to X, it will describe the curve BY by the combined action of these two forces, in the same time that the projectile force singly would have carried it from B to X, or the gravitating power singly have caused it to descend from B to y; and these two forces being duly proportioned, and perpendicular to one another, the planet obeying them both, will move in the circle $BYTU$.

But if, whilst the projectile force carries the planet from B to b, the sun's attraction (which constitutes the planet's gravitation) should bring it down from B to 1, the gravitating power would then be too strong for the projectile force, and would cause the planet to describe the curve BC. When the planet comes to C, the gravitating power (which always increases as the square of the distance from the sun S diminishes) will be yet stronger for the projectile force; and by conspiring in some degree therewith, will accelerate the planet's motion all the way from C to K, causing it to describe the arcs, BC, CD, DE, EF, &c. all in equal times. Having its motion thus accelerated, it thereby gains so much centrifugal force, or tendency to fly off at K in the line Kk, as overcomes the sun's attraction; and the centrifugal force being too great to allow the planet to be brought nearer the sun, or even to move round him in the circle $Klmn$, &c. it goes off, and ascends in the curve $KLMN$, &c. its motion decreasing as gradually from K to B, as it increased from B to K, because the sun's attraction acts now against the planet's projectile motion just as much as it acted with it before. When the planet has got round to B, its projectile force is as much diminished from its mean state about G or N, as it was augmented at K; and so, the sun's attraction being more than sufficient to keep the planet from going off at B, it describes the same orbit over again, by virtue of the same forces or powers.

A double projectile force will always balance a quadruple power of gravity. Let the planet at B have twice as great an impulse from thence towards X, as it had before; that is, in the same length of time that it was projected from B to b, as in the last example, let it now be projected from B to c, and it will require four times as much gravity to retain it in its orbit; that is, it must fall as far as from B to 4 in the time that the projectile force would carry it from B to c, otherwise it could not describe the curve BD, as is evident by the figure. But in as much time as the planet moves from B to C in the higher part of its orbit, it moves from I to K, or from K to L, in the lower part thereof; because, from the joint action of these two forces, it must always describe equal areas in equal times, throughout its annual course. These areas are represented by the triangles BSC, CSD, DSE, ESF, &c. whose contents are equal to one another, quite round the figure.

As the planets approach nearer the sun, and recede farther from him in every revolution, there may be some difficulty in conceiving the reason why the power of gravity, when it once gets the better of the projectile force, does not bring the planets nearer and nearer the sun in every revolution, till they fall upon and unite with him; or why the projectile force, when it once gets the better of gravity, does not carry the planets farther and farther from the sun, till it removes them quite out of the sphere of his attraction, and causes them to go on in straight lines for ever afterward. But by considering the effects of these powers, this difficulty will be removed. Suppose a planet at B to be carried by the projectile force as far as from B to b, in the time that gravity would have brought it down from B to 1; by these two forces it will describe the curve BC. When the planet comes down to K, it will be but half as far from the sun S as it was at B; and therefore, by gravitating four times as strongly towards him, it would fall from K to V in the same length of time that it would have fallen from B to 1 in the higher part of its orbit, that is, through four times as much space; but its projectile force is then so much increased at K, as would carry it from K to k in the same time; being double of what it was at B, and is therefore too strong for the gravitating power, either to draw the planet to the sun, or cause it to go round him in the circle $Klmn$, &c. which would require its falling from K to w, through a greater space than gravity can draw it, whilst the projectile force is such as would carry it from K to k; and therefore the planet ascends in its orbit $KLMN$, decreasing in its velocity, for the cause already assigned.

The orbits of all the planets are ellipses, very little different from circles; but the orbits of the comets are very long ellipses, and the lower focus of them all is in the sun. If we suppose the mean distance (or middle between the greatest and least) of every planet and comet from the sun to be divided into 1000 equal parts, the excentricities of their orbits, both in such parts and in English miles, will be as follow. Mercury's 210 parts, or 6,720,000 miles; Venus's, 7 parts, or 413,000 miles; the earth's, 17 parts, or 1,377,000 miles; Mars's, 93 parts, or 11,439,000 miles; Jupiter's, 48 parts, or 20,352,000 miles; Saturn's, 55 parts, or 42,735,000 miles. Of the nearest of the three forementioned comets, 1,458,000 miles; of the middlemost, 2,025,000,000 miles; and of the outermost, 6,600,000,000.

By the laws of gravity and the projectile force, bodies will move in all kinds of ellipses, whether long or short, if the spaces they move in be void of resistance; only those which move in the longer ellipses, have so much the less projectile force impressed upon them in the higher parts of their orbits; and their velocities in coming down towards the sun are so prodigiously increased by his attraction, that their centrifugal forces in the lower parts of their orbits are so great, as to overcome the sun's attraction there, and cause them to ascend again towards the higher parts of their orbits; during which time, the sun's attraction acting so contrary to the motions of those bodies, causes them to move slower and slower, until their

their projectile forces are diminished almost to nothing; and then they are brought back again by the sun's attraction, as before.

If the projectile forces of all the planets and comets were destroyed at their mean distances from the sun, their gravities would bring them down so, as that Mercury would fall to the sun in 15 days 13 hours; Venus, in 39 days 17 hours; the earth or moon, in 64 days 10 hours; Mars, in 121 days; Jupiter, in 290; and Saturn, in 767. The nearest comet, in 13 thousand days; the middlemost, in 23 thousand days; and the outermost, in 66 thousand days. The moon would fall to the earth in 4 days 20 hours: Jupiter's first moon would fall to him in 7 hours; his second, in 15; his third, in 30; and his fourth, in 71 hours: Saturn's first moon would fall to him in 8 hours; his second, in 12; his third, in 19; his fourth, in 68; and the fifth, in 336. A stone would fall to the earth's centre, if there were an hollow passage, in 21 minutes 9 seconds. Mr Whiston gives the following rule for such computations. "It is demonstrable, that half the period of any planet, when it is diminished in the sesquialteral proportion of the number 1 to the number 2, or nearly in the proportion of 1000 to 2828, is the time that it would fall to the centre of its orbit." This proportion is, when a quantity or number contains another once and a half as much more.

The quick motions of the moons of Jupiter and Saturn round their primaries, demonstrate that these two planets have stronger attractive powers than the earth has: for the stronger that one body attracts another, the greater must be the projectile force, and consequently the quicker must be the motion of that other body to keep it from falling to its primary or central planet. Jupiter's second moon is 124 thousand miles farther from Jupiter than our moon is from us; and yet this second moon goes almost eight times round Jupiter whilst our moon goes only once round the earth. What a prodigious attractive power must the sun then have, to draw all the planets and satellites of the system towards him; and what an amazing power must it have required to put all these planets and moons into such rapid motions at first!

CHAP. VI. *Reasons why the Sun, Moon, and Stars, when rising or setting, appear larger than when they rise higher in the Heavens.*

The sun and moon appear larger in the horizon than at any considerable height above it. These luminaries, although at great distances from the earth, appear floating, as it were, on the surface of our atmosphere, (Plate XLI. fig. 1.) *HGFfeC*, a little way beyond the clouds; of which, those about *F*, directly over our heads at *E*, are nearer us than those about *H* or e in the horizon *HE*e. Therefore, when the sun or moon appear in the horizon at e, they are not only seen in a part of the sky which is really farther from us than if they were at any considerable altitude, as about *f*; but they are also seen through a greater quantity of air and vapours at e than at *f*. Here we have two concurring appearances which deceive our imagination, and cause us to refer the sun and moon to a greater distance at their rising or setting about e, than when they are considerably high, as at *f*: first, their seeming to be on a part of the atmosphere at e, which is really farther than *f* from a spectator at *E*; and, secondly, their being seen through a grosser medium when at e than when at *f*, which, by rendering them dimmer, causes us to imagine them to be at a yet greater distance. And as, in both cases, they are seen much under the same angle, we naturally judge them to be largest when they seem farthest from us.

Any one may satisfy himself that the moon appears under no greater angle in the horizon than on the meridian, by taking a large sheet of paper, and rolling it up in the form of a tube, of such a width, that observing the moon through it when she rises, she may, as it were, just fill the tube; then tie a thread round it to keep it of that size; and when the moon comes to the meridian, and appears much less to the eye, look at her again through the same tube, and she will fill it just as much, if not more, than she did at her rising.

When the full moon is in her *perigeo*, or at her least distance from the earth, she is seen under a larger angle, and must therefore appear bigger that when she is full at other times: And if that part of the atmosphere where she rises be more replete with vapours than usual, she appears so much the dimmer; and therefore we fancy her to be still the bigger, by referring her to an unusually great distance, knowing that no objects which are very far distant can appear big unless they be really so.

CHAP. VII. *Use of the common Quadrant, and the Method of finding the Distances of the Sun, Moon, and Planets.*

To enable the young astronomer to understand the method of finding the distances of the heavenly bodies, we shall here give a short description of the quadrant. This instrument (Plate XLV. fig. 6.) is chiefly used in taking altitudes.

The altitude of any celestial phenomenon is an arc of the sky intercepted between the horizon and the phenomenon. In fig. 6. of Plate XLV. let *HOX* be a horizontal line, supposed to be extended from the eye at *A* to *X*, where the sky and earth seem to meet at the end of a long and level plain; and let *S* be the sun. The arc *XY* will be the sun's height above the horizon at *X*; and is found by the instrument *EDC*, which is a quadrantal board, or plate of metal, divided into 90 equal parts or degrees on its limb *DPC*; and has a couple of little brass plates, as *a* and *b*, with a small hole in each of them, called *sight-holes*, for looking through, parallel to the edge of the quadrant whereon they stand. To the centre *E* is fixed one end of a thread *F*, called *the plumb-line*, which has a small weight or plummet *P* fixed to its other end. Now, if an observer holds the quadrant upright, without inclining it to either side, and so that the horizon at *X* is seen through the sight-holes *a* and *b*, the plumb-line will cut or hang over the beginning of the degrees

degrees at o, in the edge EC; but if he elevates the quadrant fo as to look through the fight-holes at any part of the heavens, fuppofe to the fun at S; juft fo many degrees as he elevates the fight-hole b above the horizontal line HOX, fo many degrees will the plumb-line cut in the limb CP of the quadrant. For, let the obferver's eye at A be in the centre of the celeftial arc XYV (and he may be faid to be in the centre of the fun's apparent diurnal orbit, let him be on what part of the earth he will) in which arc the fun is at that time, fuppofe 25 degrees high, and let the obferver hold the quadrant fo that he may fee the fun through the fight-holes; the plumb-line freely playing on the quadrant will cut the 25th degree in the limb GP, equal to the number of degrees of the fun's altitude at the time of obfervation. —[N. B. Whoever looks at the fun, muft have a fmoked glafs before his eyes to fave them from hurt. The better way is not to look at the fun through the fight-holes, but to hold the quadrant facing the eye, at a little diftance, and fo that the fun fhining through one hole, the ray may be feen to fall on the other.]

In fig. 2. Plate XLI. let BAG be one half of the earth, AC its femidiameter, S the fun, m the moon, and $EKOL$ a quarter of the circle defcribed by the moon in revolving from the meridian to the meridian again. Let CRS be the rational horizon of an obferver at A, extended to the fun in the heavens; and HAO his fenfible horizon, extended to the moon's orbit. ALC is the angle under which the earth's femidiameter AC is feen from the moon at L, which is equal to the angle OAL, becaufe the right lines AO and CL which include both thefe angles are parallel. ASC is the angle under which the earth's femidiameter AC is feen from the fun at S, and is equal to the angle OAf, becaufe the lines AO and CRS are parallel. Now, it is found by obfervation, that the angle OAL is much greater than the angle OAf; but OAL is equal to ALC, and OAf is equal to ASC. Now, as ASC is much lefs than ALC, it proves that the earth's femidiameter AC appears much greater as feen from the moon at L, than from the fun at S; and therefore the earth is much farther from the fun than from the moon. The quantities of thefe angles are determined by obfervation in the following manner.

Let a graduated inftrument, as DAE (the larger the better) having a moveable index with fight-holes, be fixed in fuch a manner, that its plane furface may be parallel to the plane of the equator, and its edge AD in the meridian: fo that when the moon is in the equinoctial, and on the meridian at E, fhe may be feen through the fight-holes when the edge of the moveable index cuts the beginning of the divifions at o, on the graduated limb DE; and when fhe is fo feen, let the *precife* time be noted. Now, as the moon revolves about the earth, from the meridian to the meridian again, in 24 hours 48 minutes, fhe will go a fourth part round it in a fourth part of that time, *viz.* in 6 hours 12 minutes, as feen from C, that is, from the earth's centre or pole. But as feen from A, the obferver's place on the earth's furface, the moon will feem to have gone a quarter round the earth when fhe comes to the fenfible horizon at O; for the index, through the fights of which fhe is then viewed, will be at d, 90 degrees from D, where it was when fhe was feen at E. Now, let the exact moment when the moon is feen at O (which will be when fhe is in or near the fenfible horizon) be carefully noted, that it may be known in what time fhe has gone from E to O; which time fubtracted from 6 hours 12 minutes (the time of her going from E to L) leaves the time of her going from O to L, and affords an eafy method for finding the angle OAL (called the *moon's horizontal parallax*, which is equal to the angle ALC) by the following analogy. As the time of the moon's defcribing the arc EO is to 90 degrees, fo is 6 hours 12 minutes to the degrees of the arc DdE, which meafures the angle EAL; from which fubtract 90 degrees, and there remains the angle OAL, equal to the angle ALC, under which the earth's femidiameter AC is feen from the moon. Now, fince all the angles of a right-lined triangle are equal to 180 degrees, or to two right angles, and the fides of a triangle are always proportional to the fines of the oppofite angles, fay, by the *Rule of Three*, as the fine of the angle ALC at the moon L is to its oppofite fide AC, the earth's femidiameter, which is known to be 3985 miles, fo is the radius, *viz.* the fine of 90 degrees, or of the right angle ACL, to its oppofite fide AL, which is the moon's diftance at L, from the obferver's place at A, on the earth's furface; or, fo is the fine of the angle CAL to its oppofite fide CL, which is the moon's diftance from the earth's centre, and comes out, at a mean rate, to be 240,000 miles. The angle CAL is equal to what OAL wants of 90 degrees.

The fun's diftance from the earth is found the fame way, but with much greater difficulty; becaufe his horizontal parallax, or the angle OAS equal to the angle ASC, is fo fmall as to be hardly perceptible, being only 10 feconds of a minute, or the 360th part of a degree. But the moon's horizontal parallax, or angle OAL, equal to the angle ALC, is very difcernible, being $57' 49''$, or $3469''$ at its mean ftate; which is more than 340 times as great as the fun's: And therefore the diftances of the heavenly bodies being inverfely as the tangents of their horizontal parallaxes, the fun's diftance from the earth is at leaft 340 times as great as the moon's; and is rather underftated at 81 millions of miles, when the moon's diftance is certainly known to be 240 thoufand. But becaufe, according to fome aftronomers, the fun's horizontal parallax is 11 feconds, and according to others only 10, the former parallax making the fun's diftance to be about 75,000,000 of miles, and the latter 82,000,000; we may take it for granted, that the fun's diftance is not lefs than as deduced from the former, nor more than as fhewn by the latter: And every one who is accuftomed to make fuch obfervations, knows how hard it is, if not impoffible, to avoid an error of a fecond, efpecially on account of the inconftancy of horizontal refractions: And here, the error of one fecond, in fo fmall an angle, will make an error of feven millions of miles in fo great a diftance as that of the fun's.

The fun and moon appear much about the fame bulk; and every one who underftands geometry, knows how their true bulks may be deduced from the apparent, when their real diftances are known. Spheres are to one another

Plate.XL.

Fig. 3.

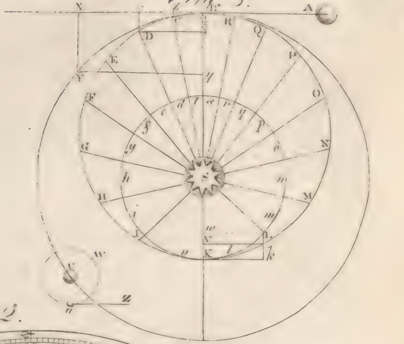


Fig. 1.

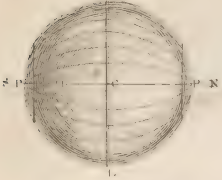
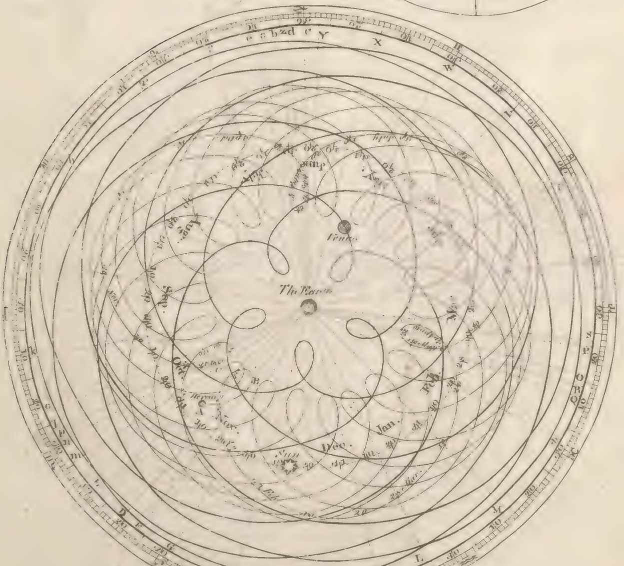


Fig. 2.



A. Bell Sculp.

another as the cubes of their diameters; whence, if the ſun be 81 millions of miles from the earth, to appear as big as the moon, whoſe diſtance does not exceed 240 thouſand miles, he muſt, in ſolid bulk, be 42 millions 875 thouſand times as big as the moon.

The horizontal parallaxes are beſt obſerved at the equator. 1. Becauſe the heat is ſo nearly equal every day, that the refractions are almoſt conſtantly the ſame. 2. Becauſe the parallactic angle is greater there, as at *A* (the diſtance from thence to the earth's axis being greater) than upon any parallel of latitude, as *a* or *b*.

The earth's diſtance from the ſun being determined, the diſtances of all the other planets from him are eaſily found by the following analogy, their periods round him being aſcertained by obſervation. As the ſquare of the earth's period round the ſun is to the cube of its diſtance from him, ſo is the ſquare of the period of any other planet to the cube of its diſtance, in ſuch parts or meaſures as the earth's diſtance was taken. This proportion gives us the relative mean diſtances of the planets from the ſun to the greateſt degree of exactneſs; and they are as follow, having been deduced from their periodical times, according to the law juſt mentioned, which was diſcovered by Kepler, and demonſtrated by Sir Iſaac Newton.

Periodical Revolution to the ſame fixed Star in Days, and decimal Parts of a Day.

Of Mercury,	Venus,	The Earth,	Mars,	Jupiter,	Saturn,
87.9692	224.6176	365.2564	686.9785	4332.514	10759.275
Relative mean diſtances from the ſun.					
38710	72333	100000	152369	520096	954006
From theſe numbers we deduce, that if the ſun's horizontal parallax be 10″, the real mean diſtances of the planets from the ſun in Engliſh miles are,					
31,742,200	59,313,060	82,000,000	124,942,580	426,478,720	782,284,920
But if the ſun's parallax be 11″, their diſtances are no more than					
29,032,500	54,238,570	75,000,000	114,276,750	390,034,500	715,504,500
Errors in diſtance, ariſing from the miſtake of 1″ in the ſun's parallax.					
2,709,700	5,074,490	7,000,000	10,665,830	36,444,220	66,780,420
But, from the tranſit of Venus, A. D. 1761, *the ſun's parallax appears to be only* 8″ $\frac{60}{100}$; *and according to that, their real diſtance in miles are*					
36,668,373	68,518,044	94,725,840	144,588,575	492,665,307	903,690,197

Theſe numbers ſhew, that although we have the relative diſtances of the planets from the ſun to the greateſt nicety, yet the beſt obſervers could not aſcertain their true diſtances until the above tranſit appeared, which we muſt confeſs was embarraſſed with ſeveral difficulties. But the late tranſit of Venus over the ſun, on the third of June, was much better ſuited to this great problem.

The earth's axis produced to the ſtars, being carried parallel to itſelf during the earth's annual revolution, deſcribes a circle in the ſphere of the fixed ſtars equal to the orbit of the earth. But this orbit, though very large, would ſeem no bigger than a point if it were viewed from the ſtars; and conſequently, the circle deſcribed in the ſphere of the ſtars, by the axis of the earth produced, if viewed from the earth, muſt appear but as a point; that is, its diameter appears too little to be meaſured by obſervation: For Dr Bradley has aſſured us, that if it had amounted to a ſingle ſecond, or two at moſt, he ſhould have perceived it in the great number of obſervations he has made, eſpecially upon γ *dragonis*; and that it ſeemed to him very probable that the annual parallax of this ſtar is not ſo great as a ſingle ſecond; and conſequently, that it is above 400 thouſand times farther from us than the ſun. Hence, the celeſtial poles ſeem to continue in the ſame points of the heavens throughout the year; which, by no means, diſproves the earth's annual motion, but plainly proves the diſtance of the ſtars to be exceeding great.

The ſmall apparent motion of the ſtars, diſcovered by that great aſtronomer, he found to be no ways owing to their annual parallax (for it came out contrary thereto) but to the aberration of their light, which can reſult from no known cauſe beſides that of the earth's annual motion; and as it agrees ſo exactly therewith, it proves, beyond diſpute, that the earth has ſuch a motion: For this aberration completes all its various phenomena every year; and proves that the velocity of ſtar-light is ſuch as carries it through a ſpace equal to the ſun's diſtance from us in 8 minutes 13 ſeconds of time. Hence, the velocity of light is 10 thouſand 210 times as great as the earth's velocity in its orbit; which velocity (from what we know already of the earth's diſtance from the ſun) may be aſſerted to be at leaſt between 57 and 58 thouſand miles every hour: And ſuppoſing it to be 58000, this number, multiplied by the above 10210, gives 592 million 180 thouſand miles for the hourly motion of light; which laſt number, divided by 3600, the number of ſeconds in an hour, ſhews that light flies at the rate of more than a hundred and ſixty-four thouſand miles every ſecond of time, or ſwing of a common clock pendulum.

Chap. VIII. *The different Lengths of Days and Nights, and the Viciſſitudes of Seaſons, explained. The Explanation of the Phenomena of Saturn's Ring concluded.*

The following experiment will give a plain idea of the diurnal and annual motions of the earth, together with the different lengths of days and nights, and all the beautiful variety of ſeaſons, depending on thoſe motions.

Take about ſeven feet of ſtrong wire, and bend it into a circular form, as abcd, which being viewed obliquely, appears elliptical, Plate XLI. fig. 3. Place a lighted candle on a table, and having fixed one end of a ſilk thread *K*, to the north pole of a ſmall terreſtrial globe *H*, about three inches diameter, cauſe another perſon to hold the wire circle, ſo that it may be parallel to the table, and as high as the flame of the candle *I*, which ſhould be in or near the centre. Then, having twiſted the thread as towards the left-hand, that by untwiſting it may turn the globe round eaſtward, or contrary to the way that the hands of a watch move; hang the globe by the thread within this circle, almoſt contiguous to it; and as the thread untwiſts, the globe (which is enlightened half round by the candle as the earth is by the ſun) will turn round its axis, and the different places upon it will be carried through the light and dark hemiſpheres, and have the appearance of a regular ſucceſſion of days and nights, as our earth has in reality by ſuch a motion. As the globe turns, move your hand ſlowly, ſo as to carry the globe round the candle according to the order of the letters abcd, keeping its centre even with the wire circle; and you will perceive, that the candle being ſtill perpendicular to the equator, will enlighten the globe from pole to pole in its whole motion round the circle; and that every place on the globe goes equally through the light and the dark, as it turns round by the untwiſting of the thread, and therefore has a perpetual equinox. The globe, thus turning round, repreſents the earth turning round its axis; and the motion of the globe round the candle repreſents the earth's annual motion round the ſun, and ſhews, that if the earth's orbit had no inclination to its axis, all the days and nights of the year would be equally long, and there would be no different ſeaſons. But now, deſire the perſon who holds the wire, to hold it obliquely in the poſition *ABCD*, raiſing the ſide ♋ juſt as much as he depreſſes the ſide *rs*, that the flame may be ſtill in the plane of the circle; and twiſting the thread as before, that the globe may turn round its axis the ſame way as you carry it round the candle, that is, from weſt to eaſt, let the globe down into the lowermoſt part of the wire circle at *rs*, and if the circle be properly inclined, the candle will ſhine perpendicularly on the tropic of Cancer, and the frigid zone, lying within the arctic or north polar circle, will be all in the light, as in the figure; and will keep in the light, let the globe turn round its axis ever ſo often. From the equator to the north polar circle all the places have longer days and ſhorter nights; but from the equator to the ſouth polar circle juſt the reverſe. The ſun does not ſet to any part of the north frigid zone, as ſhewn by the candle's ſhining on it, ſo that the motion of the globe can carry no place of that zone into the dark: And, at the ſame time, the ſouth frigid zone is involved in darkneſs, and the turning of the globe brings none of its places into the light. If the earth were to continue in the like part of its orbit, the ſun would never ſet to the inhabitants of the north frigid zone, nor riſe to thoſe of the ſouth. At the equator it would be always equal day and night; and as places are gradually more and more diſtant from the equator, towards the arctic circle, they would have longer days and ſhorter nights; whilſt thoſe on the ſouth ſide of the equator would have their nights longer than their days. In this caſe there would be continual ſummer on the north ſide of the equator, and continual winter on the ſouth ſide of it.

But as the globe turns round its axis, move your hand ſlowly forward, ſo as to carry the globe from *H* towards *E*, and the boundary of light and darkneſs will approach towards the north pole, and recede towards the ſouth pole; the northern places will go through leſs and leſs of the light, and the ſouthern places through more and more of it; ſhewing how the northern days decreaſe in length, and the ſouthern days increaſe, whilſt the globe proceeds from *H* to *E*. When the globe is at *E*, it is at a mean ſtate between the loweſt and higheſt part of its orbit; the candle is directly over the equator, the boundary of light and darkneſs juſt reaches to both the poles, and all places on the globe go equally through the light and dark hemiſpheres, ſhewing that the days and nights are then equal at all places of the earth, the poles only excepted; for the ſun is then ſetting to the north pole, and riſing to the ſouth pole.

Continue moving the globe forward, and as it goes thro' the quarter *A*, the north pole recedes ſtill farther into the dark hemiſphere, and the ſouth pole advances more into the light, as the globe comes nearer to ♋: And when it comes there at *F*, the candle is directly over the tropic of Capricorn, the days are at the ſhorteſt, and nights at the longeſt, in the northern hemiſphere, all the way from the equator to the arctic circle; and the reverſe in the ſouthern hemiſphere from the equator to the antarctic circle; within which circles it is dark to the north frigid zone, and light to the ſouth.

Continue both motions, and as the globe moves through the quarter *B*, the north pole advances towards the light, and the ſouth pole recedes towards the dark; the days lengthen in the northern hemiſphere, and ſhorten in the ſouthern; and when the globe comes to *G*, the candle will be again over the equator (as when the globe was at *E*) and the days and nights will again be equal as formerly; and the north pole will be juſt coming into the light, the ſouth pole going out of it.

Thus we ſee the reaſon why the days lengthen and ſhorten from the equator to the polar circles every year; why there is no day or night for ſeveral turnings of the earth, within the polar circles; why there is but one day and one night in the whole year at the poles; and why the days and nights are equally long all the year

year round at the equator, which is always equally cut by the circle bounding light and darkneſs.

The inclination of an axis or orbit is merely relative, becauſe we compare it with ſome other axis or orbit which we conſider as not inclined at all. Thus, our horizon being level to us whatever place of the earth we are upon, we conſider it as having no inclination; and yet, if we travel 90 degrees from that place, we ſhall then have an horizon perpendicular to the former, but it will ſtill be level to us. And if this book be held ſo that the circle *ABCD* be parallel to the horizon, both the circle abcd, and the thread or axis *K*, will be inclined to it. But if the book or plate be held ſo that the thread be perpendicular to the horizon, then the orbit *ABCD* will be inclined to the thread, and the orbit abcd perpendicular to it, and parallel to the horizon. We generally conſider the earth's annual orbit as having no inclination, and the orbits of all the other planets as inclined to it.

Let us now take a view of the earth in its annual courſe round the ſun, conſidering its orbit as having no inclination, and its axis as inclining $23\frac{1}{2}$ degrees from a line perpendicular to the plane of its orbit, and keeping the ſame oblique direction in all parts of its annual courſe; or, as commonly termed, keeping always parallel to itſelf.

In Plate XLI. fig. 4. let *abcdefgh* be the earth in eight different parts of its orbit, equidiſtant from one another, *Ns* its axis, *N* the north pole, *s* the ſouth pole, and *S* the ſun nearly in the centre of the earth's orbit. As the earth goes round the ſun according to the order of the letters *abcd*, &c. its axis *Ns* keeps the ſame obliquity, and is ſtill parallel to the line *MNs*. When the earth is at *a*, its north pole inclines toward the ſun *S*, and brings all the northern places more into the light than at any other time of the year. But when the earth is at *e* in the oppoſite time of the year, the north pole declines from the ſun, which occaſions the northern places to be more in the dark than in the light; and the reverſe at the ſouthern places, as is evident by the figure. When the earth is either at *c* or *g*, its axis inclines not either to or from the ſun, but lies ſidewiſe to him, and then the poles are in the boundary of light and darkneſs; and the ſun, being directly over the equator, makes equal day and night at all places. When the earth is at *b*, it is half way between the ſummer ſolſtice and harveſt equinox; when it is at *d*, it is half way from the harveſt equinox to the winter ſolſtice; at *f*, half way from the winter ſolſtice to the ſpring equinox; and at *h*, half way from the ſpring equinox to the ſummer ſolſtice.

From this oblique view of the earth's orbit, let us ſuppoſe ourſelves to be raiſed far above it, and placed juſt over its centre *S*, looking down upon it from its north pole; and as the earth's orbit differs but very little from a circle, we ſhall have its figure in ſuch a view repreſented by the circle *ABCDEFGH* (Plate XLII. fig. 1.). Let us ſuppoſe this circle to be divided into 12 equal parts, called *ſigns*, having their names affixed to them; and each ſign into 30 equal parts, called *degrees*, numbered 10, 20, 30, as in the outermoſt circle of the figure, which repreſents the great ecliptic in the heavens. The earth is ſhewn in eight different poſitions in this circle, and in each poſition *Æ* is the equator, *T* the tropic of Cancer, the *dotted circle* the parallel of London, *U* the arctic or north polar circle, and *P* the north pole, where all the meridians or hour-circles meet. As the earth goes round the ſun, the north pole keeps conſtantly towards one part of the heavens, as it keeps in the figure towards the right-hand ſide of the plate.

When the earth is at the beginning of Libra, namely, on the 20th of March, in this figure (as at *g* in Plate XLI. fig. 4.) the ſun *S* as ſeen from the earth appears at the beginning of Aries in the oppoſite part of the heavens, the north pole is juſt coming into the light, and the ſun is vertical to the equator; which, together with the tropic of Cancer, parallel of London, and arctic circle, are all equally cut by the circle bounding light and darkneſs, coinciding with the ſix o'clock hour-circle, and therefore the days and nights are equally long at all places; for every part of the meridian *ÆTL*a comes into the light at ſix in the morning, and revolving with the earth according to the order of the hour-letters, goes into the dark at ſix in the evening. There are 24 meridians or hour-circles drawn on the earth in this figure, to ſhew the time of ſun-riſing and ſetting at different ſeaſons of the year.

As the earth moves in the ecliptic according to the order of the letters *ABCD*, &c. through the ſigns Libra, Scorpio, and Sagittarius, the north pole comes more and more into the light; the days increaſe as the nights decreaſe in length, at all places north of the equator *Æ*; which is plain by viewing the earth at *b* on the 5th of May, when it is in the 15th degree of Scorpio, and the ſun as ſeen from the earth appears in the 15th degree of Taurus; for then the tropic of Cancer *T* is in the light from a little after five in the morning till almoſt ſeven in the evening; the parallel of London from half an hour paſt four till half an hour paſt ſeven; the polar circle *U* from three till nine; and a large track round the north pole *P* has day all the 24 hours, for many rotations of the earth on its axis.

When the earth comes to *c* at the beginning of Capricorn, and the ſun as ſeen from the earth appears at the beginning of Cancer on the 21ſt of June, as in this figure, it is in the poſition *a* in Plate XLI. fig. 4.; and its north pole inclines towards the ſun, ſo as to bring all the north frigid zone into the light, and the northern parallels of latitude more into the light than the dark from the equator to the polar circle, and the more ſo as they are farther from the equator. The tropic of Cancer is in the light from five in the morning till ſeven at night; the parallel of London from a quarter before four till a quarter after eight; and the polar circle juſt touches the dark, ſo that the ſun has only the lower half of his diſk hid from the inhabitants on that circle for a few minutes about midnight, ſuppoſing no inequalities in the horizon, and no refractions.

A bare view of the figure is enough to ſhew, that as the earth advances from Capricorn towards Aries, and the ſun appears to move from Cancer towards Libra, the north pole recedes towards the dark, which cauſes the days to decreaſe, and the nights to increaſe in length, till

till the earth comes to the beginning of Aries, and then they are equal as before; for the boundary of light and darkneſs cut the equator and all its parallels equally or in halves. The north pole then goes into the dark, and continues therein until the earth goes half way round its orbit, or from the 23d of September till the 20th of March. In the middle between theſe times, *viz.* on the 22d of December, the north pole is as far as it can be in the dark, which is 23½ degrees, equal to the inclination of the earth's axis from a perpendicular to its orbit; and then the northern parallels are as much in the dark as they were in the light on the 21ſt of June; the winter nights being as long as the ſummer days, and the winter days as ſhort as the ſummer nights. It is needleſs to enlarge farther on this ſubject, as we ſhall have occaſion to mention the ſeaſons again in deſcribing the orrery. Only this muſt be noted, that all that has been ſaid of the northern hemiſphere, the contrary muſt be underſtood of the ſouthern; for on different ſides of the equator the ſeaſons are contrary, becauſe when the northern hemiſphere inclines towards the ſun, the ſouthern declines from him.

As Saturn goes round the ſun, his obliquely poſited ring, like our earth's axis, keeps parallel to itſelf, and is therefore turned edgewiſe to the ſun twice in a Saturnian year, which is almoſt as long as 30 of our years. But the ring, though conſiderably broad, is too thin to be ſeen by us when it is turned round edgewiſe to the ſun, at which time it is alſo edgewiſe to the earth, and therefore it diſappears once in every fifteen years to us. As the ſun ſhines half a year together on the north pole of our earth, then diſappears to it, and ſhines as long on the ſouth pole; ſo, during one half of Saturn's year, the ſun ſhines on the north ſide of his ring, then diſappears to it, and ſhines as long on its ſouth ſide. When the earth's axis inclines neither to nor from the ſun, but ſidewiſe to him, he inſtantly ceaſes to ſhine on one pole, and begins to enlighten the other; and when Saturn's ring inclines neither to nor from the ſun, but ſidewiſe to him, he ceaſes to ſhine on the one ſide of it, and begins to ſhine upon the other.

The earth's orbit being elliptical, and the ſun conſtantly keeping in its lower focus, which is 1,377,000 miles from the middle point of the longer axis, the earth comes twice ſo much, or 2,754,000 miles nearer the ſun at one time of the year than at another; for the ſun appearing under a larger angle in our winter than ſummer, proves that the earth is nearer the ſun in winter. But here this natural queſtion will ariſe, Why have we not the hotteſt weather when the earth is neareſt the ſun? In anſwer, it muſt be obſerved, that the excentricity of the earth's orbit, or 1 million 377 miles, bears no greater proportion to the earth's mean diſtance from the ſun than 17 does to 1000; and therefore this ſmall difference of diſtance cannot occaſion any great difference of heat or cold. But the principal cauſe of this difference is, that in winter the ſuns rays fall ſo obliquely upon us, that any given number of them is ſpread over a much greater portion of the earth's ſurface where we live, and therefore each point muſt then have fewer rays than in ſummer. Moreover, there comes a greater degree of cold in the long winter nights than there can return of heat in ſo ſhort days; and on both theſe accounts the cold muſt increaſe. But in ſummer, the rays fall more perpendicularly upon us, and therefore come with greater force, and in greater numbers on the ſame place; and by their long continuance, a much greater degree of heat is imparted by day than can fly off by night.

CHAP. IX. *The Method of finding the Longitude by the Eclipſes of Jupiter's Satellites: The amazing Velocity of Light demonſtrated by theſe Eclipſes.*

GEOGRAPHERS arbitrarily chuſe to call the meridian of ſome remarkable place the *firſt meridian.* There they begin their reckoning; and juſt ſo many degrees and minutes as any other place is to the eaſtward or weſtward of that meridian, ſo much eaſt or weſt longitude they ſay it has. A degree is the 360th part of a circle, be it great or ſmall; and a minute the 60th part of a degree. The Engliſh geographers reckon the longitude from the meridian of the Royal Obſervatory at Greenwich, and the French from the meridian of Paris.

If we imagine 12 great circles, (Plate XLII. fig. 1.) one of which is the meridian of any given place, to interſect each other in the two poles of the earth, and to cut the equator Æ at every 15th degree, they will be divided by the poles into 24 ſemicircles which divide the equator into 24 equal parts; and as the earth turns on its axis, the planes of theſe ſemicircles come ſucceſſively after one another every hour to the ſun. As in an hour of time there is a revolution of 15 degrees of the equator, in a minute of time there will be a revolution of 15 minutes of the equator, and in a ſecond of time a revolution of 15 ſeconds.

Becauſe the ſun enlightens only one half of the earth at once, as it turns round its axis, he riſes to ſome places at the ſame moments of abſolute time that he ſets to others; and when it is mid-day to ſome places, it is midnight to others. The XII on the middle of the earth's enlightened ſide, next the ſun, ſtands for mid-day; and the oppoſite XII on the middle of the dark ſide, for midnight. If we ſuppoſe this circle of hours to be fixed in the plane of the equinoctial, and the earth to turn round within it, any particular meridian will come to the different hours ſo as to ſhew the true time of the day or night at all places on that meridian. Therefore,

To every place 15 degrees eaſtward from any given meridian, it is noon an hour ſooner than on that meridian, becauſe their meridian comes to the ſun an hour ſooner; and to all places 15 degrees weſtward, it is noon an hour later, becauſe their meridian comes an hour later to the ſun, and ſo on; every 15 degrees of motion cauſing an hour's difference in time. Therefore, they who have noon an hour later than we, have their meridian, that is, their longitude, 15 degrees weſtward from us; and they who have noon an hour ſooner than we, have their meridian 15 degrees eaſtward from ours; and ſo for every hour's difference of time 15 degrees difference

Plate XLI.

Fig. 1.

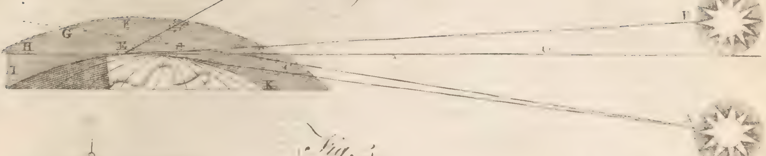


Fig. 2.

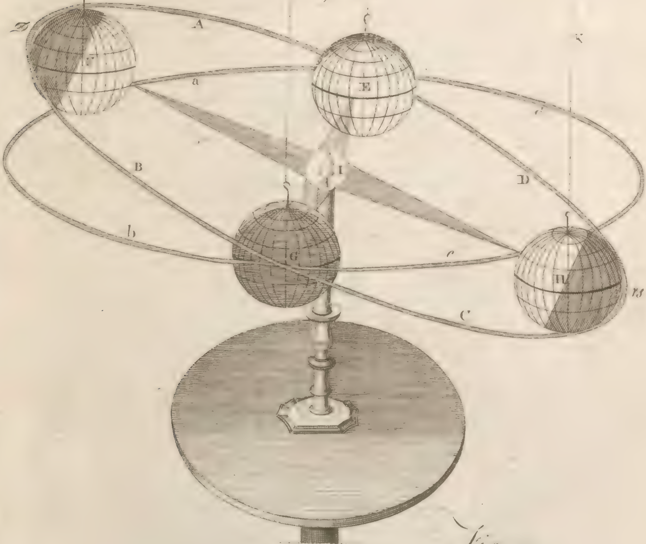


Fig. 3.

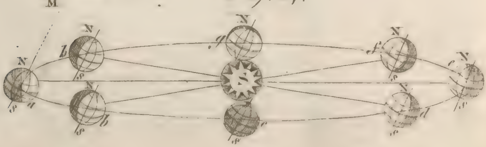
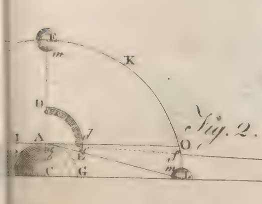


Fig. 2.



J. Bell Sculp.

rence of longitude. Confequently, if the beginning or ending of a lunar eclipfe be obferved, fuppofe at London, to be exactly at midnight, and in fome other place at 11 at night, that place is 15 degrees weftward from the meridian of London; if the fame eclipfe be obferved at 1 in the morning at another place, that place is 15 degrees eaftward from the faid meridian.

But as it is not eafy to determine the exact moment either of the beginning or ending of a lunar eclipfe, becaufe the earth's fhadow, through which the moon paffes, is faint and ill defined about the edges, we have recourfe to the eclipfes of Jupiter's fatellites, which difappear fo inftantaneoufly as they enter Jupiter's fhadow, and emerge fo fuddenly out of it, that we may fix the phenomenon to half a fecond of time. The firft or neareft fatellite to Jupiter is the moft advantageous for this purpofe, becaufe its motion is quicker than the motion of any of the reft, and therefore its immerfions and emerfions are more frequent.

The Englifh aftronomers have calculated tables for fhewing the times of the eclipfes of Jupiter's fatellites to great precifion, for the meridian of Greenwich. Now, let an obferver, who has thefe tables, with a good telefcope and a well-regulated clock at any other place of the earth, obferve the beginning or ending of an eclipfe of one of Jupiter's fatellites, and note the precife moment of time that he faw the fatellite either immerge into, or emerge out of the fhadow, and compare that time with the time fhewn by the tables for Greenwich; then, 15 degrees difference of longitude being allowed for every hour's difference of time, will give the longitude of that place from Greenwich, as above; and if there be any odd minutes of time, for every minute a quarter of a degree, eaft or weft, muft be allowed, as the time of obfervation is later or earlier than the time fhewn by the tables. Such eclipfes are very convenient for this purpofe at land, becaufe they happen almoft every day; but are of no ufe at fea, becaufe the rolling of the fhip hinders all nice telefcopical obfervations.

To explain this by a figure, in Plate XLII. fig. 1. let *J* be Jupiter, *K*, *L*, *M*, *N* his four fatellites in their refpective orbits, 1, 2, 3, 4; and let the earth be at f, (fuppofe in November, although that month is no otherwife material than to find the earth readily in this fcheme, where it is fhewn in eight different parts of its orbit). Let *Q* be a place on the meridian of Greenwich, and *R* a place on fome other meridian eaftward from Greenwich. Let a perfon at *R* obferve the inftantaneous vanifhing of the firft fatellite *K* into Jupiter's fhadow, fuppofe at three o'clock in the morning; but by the tables he finds the immerfion of that fatellite to be at midnight at Greenwich; he can then immediately determine, that as there are three hours difference of time between *Q* and *R*; and that *R* is three hours forwarder in reckoning than *Q*, it muft be 45 degrees of eaft longitude from the meridian of *Q*. Were this method as practicable at fea as at land, any failor might almoft as eafily, and with equal certainty, find the longitude as the latitude.

Whilft the earth is going from *C* to *F* in its orbit, only the immerfions of Jupiter's fatellites into his fhadow are generally feen; and their emerfions out of it while the earth goes from *G* to *B*. Indeed, both thefe appearances may be feen of the fecond, third, and fourth fatellite when eclipfed, whilft the earth is between *D* and *E*, or between *G* and *A*; but never of the firft fatellite, on account of the fmallnefs of its orbit and the bulk of Jupiter, except only when Jupiter is directly oppofite to the fun, that is, when the earth is at g; and even then, ftrictly fpeaking, we cannot fee either the immerfions or emerfions of any of his fatellites, becaufe his body being directly between us and his conical fhadow, his fatellites are hid by his body a few moments before they touch his fhadow; and are quite emerged from thence before we can fee them, as it were, juft dropping from him. And when the earth is at *c*, the fun, being between it and Jupiter, hides both him and his moons from us.

In this diagram, the orbits of Jupiter's moons are drawn in true proportion to his diameter; but, in proportion to the earth's orbit, they are drawn 81 times too large.

In whatever month of the year Jupiter is in conjunction with the fun, or in oppofition to him, in the next year it will be a month later at leaft. For whilft the earth goes once round the fun, Jupiter defcribes a twelfth part of his orbit. And therefore, when the earth has finifhed its annual period, from being in a line with the fun and Jupiter, it muft go as much forwarder as Jupiter has moved in that time, to overtake him again; juft like the minute-hand of a watch, which muft, from any conjunction with the hour-hand, go once round the dial-plate and fomewhat above a twelfth part more, to overtake the hour-hand again.

It is found by obfervation, that when the earth is between the fun and Jupiter, as at g, his fatellites are eclipfed about 8 minutes fooner than they fhould be according to the tables; and when the earth is at *B* or *C*, thefe eclipfes happen about 8 minutes later than the tables predict them. Hence it is undeniably certain, that the motion of light is not inftantaneous, fince it takes about $16\frac{1}{2}$ minutes of time to go through a fpace equal to the diameter of the earth's orbit, which is 162 millions of miles in length; and confequently the particles of light fly about 164 thoufand 494 miles every fecond of time, which is above a million of times fwifter than the motion of a cannon-bullet. And as light is $16\frac{1}{4}$ minutes in travelling acrofs the earth's orbit, it muft be $8\frac{1}{4}$ minutes in coming from the fun to us; therefore if the fun were annihilated, we fhould fee him for $8\frac{1}{4}$ minutes after; and if he were again created, he would be $8\frac{1}{4}$ minutes old before we could fee him.

To illuftrate this progreffive motion of light, (Plate XLII. fig. 2.), let *A* and *B* be the earth in two different parts of its orbit, whofe diftance from each other is 81 millions of miles, equal to the earth's diftance from the fun *S*. It is plain, that if the motion of light were inftantaneous, the fatellite 1 would appear to enter into Jupiter's fhadow *FF* at the fame moment of time to a fpectator in *A*, as to another in *B*. But by many years obfervations it has been found, that the immerfion of the fatellite into the fhadow is feen $8\frac{1}{4}$ minutes fooner when the earth is at *B*, than when it is at *A*. And fo, as

Mr Romeur first discovered, the motion of light is thereby proved to be progressive, and not instantaneous, as was formerly believed. It is easy to compute in what time the earth moves from A to B; for the chord of 60 degrees of any circle is equal to the semidiameter of that circle; and as the earth goes through all the 360 degrees of its orbit in a year, it goes through 60 of those degrees in about 61 days. Therefore, if on any given day, suppose the first of June, the earth is at A, on the first of August it will be at B; the chord, or straight line AB, being equal to DS the radius of the earth's orbit, the same with AS its distance from the sun.

As the earth moves from D to C, through the side AB of its orbit, it is constantly meeting the light of Jupiter's satellites sooner, which occasions an apparent acceleration of their eclipses; and as it moves through the other half H of its orbit, from C to D, it is receding from their light, which occasions an apparent retardation of their eclipses, because their light is then longer before it overtakes the earth.

That these accelerations of the immersions of Jupiter's satellites into his shadow, as the earth approaches towards Jupiter, and the retardations of their emersions out of his shadow, as the earth is going from him, are not occasioned by any inequality arising from the motions of the satellites in excentric orbits, is plain, because it affects them all alike, in whatever parts of their orbits they are eclipsed. Besides, they go often round their orbits every year, and their motions are no way commensurate to the earth's. Therefore, a phenomenon not to be accounted for from the real motions of the satellites, but so easily deducible from the earth's motion, and so answerable thereto, must be allowed to result from it. This affords one very good proof of the earth's annual motion.

CHAP. X. *Of Solar and Sydereal Time.*

THE fixed stars appear to go round the earth in 23 hours 56 minutes 4 seconds, and the sun in 24 hours; so that the stars gain three minutes 56 seconds upon the sun every day, which amounts to one diurnal revolution in a year; and therefore, in 365 miles, as measured by the returns of the sun to the meridian, there are 366 days, as measured by the stars returning to it; the former are called *solar days*, and the latter *sydereal*.

The diameter of the earth's orbit is but a physical point in proportion to the distance of the stars; for which reason, and the earth's uniform motion on its axis, any given meridian will revolve from any star to the same star again in every absolute turn of the earth on its axis, without the least perceptible difference of time shewn by a clock which goes exactly true.

If the earth had only a diurnal motion, without an annual, any given meridian would revolve from the sun to the sun again in the same quantity of time as from any star to the same star again, because the sun would never change his place with respect to the stars. But as the earth advances almost a degree eastward in its orbit in the time that it turns eastward round its axis, whatever star passes over the meridian on any day with the sun, will pass over the same meridian on the next day when the sun is almost a degree short of it; that is, 3 minutes 56 seconds sooner. If the year contained only 360 days, as the ecliptic does 360 degrees, the sun's apparent place, so far as his motion is equable, would change a degree every day; and then the sydereal days would be just four minutes shorter than the solar.

In Plate XLII. fig. 3. let $ABCDEFGHIKLM$ be the earth's orbit, in which it goes round the sun every year, according to the order of the letters, that is, from west to east; and turns round its axis the same way from the sun to the sun again every 24 hours. Let S be the sun, and R a fixed star, at such an immense distance, that the diameter of the earth's orbit bears no sensible proportion to that distance. Let Nm be any particular meridian of the earth, and N a given point or place upon that meridian. When the earth is at A, the sun S hides the star R, which would always be hid if the earth never removed from A; and consequently, as the earth turns round its axis, the point N would always come round to the sun and star at the same time. But when the earth has advanced, suppose a twelfth part of its orbit from A to B, its motion round its axis will bring the point N a twelfth part of a natural day, or two hours, sooner to the star than to the sun; for the angle NBn is equal to the angle ASB; and therefore any star, which comes to the meridian at noon with the sun when the earth is at A, will come to the meridian at 10 in the forenoon when the earth is at B. When the earth comes to C, the point N will have the star on its meridian at 8 in the morning, or four hours sooner than it comes round to the sun; for it must revolve from N to n, before it has the sun in its meridian. When the earth comes to D, the point N will have the star on its meridian at 6 in the morning, but that point must revolve six hours more from N to n, before it has mid-day by the sun: For now the angle ASD is a right angle, and so is NDn; that is, the earth has advanced 90 degrees in its orbit, and must turn 90 degreee on its axis to carry the point N from the star to the sun: For the star always comes to the meridian when Nm is parallel to RSA; because DS is but a point in respect of RS. When the earth is at E, the star comes to the meridian at 4 in the morning; at F, at 2 in the morning; and at G, the earth having gone half round its orbit, N points to the star R at midnight, it being then directly opposite to the sun; and therefore, by the earth's diurnal motion, the star comes to the meridian 12 hours before the sun. When the earth is at H, the star comes to the meridian at 10 in the evening; at I, it comes to the meridian 8, that is, 16 hours before the sun; at K, 18 hours before him; at L, 20 hours; at M, 22; and at A, equally with the sun again.

Thus it is plain, that an absolute turn of the earth on its axis (which is always completed when any particular meridian comes to be parallel to its situation at any time of the day before) never brings the same meridian round from the sun to the sun again; but that the earth requires as much more than one turn on its axis to finish a natural day, as it has gone forward in that time; which, at a mean

mean ſtate, is a 365th part of a circle. Hence, in 365 days the earth turns 366 times round its axis; and therefore, as a turn of the earth on its axis completes a ſydereal day, there muſt be one ſydereal day more in a year than the number of ſolar days, be the number what it will, on the earth, or any other planet. One turn being loſt with reſpect to the number of ſolar days in a year, by the planets going round the ſun; juſt as it would be loſt to a traveller, who, in going round the earth, would loſe one day by following the apparent diurnal motion of the ſun; and conſequently would reckon one day leſs at his return (let him take what time he would to go round the earth) than thoſe who remained all the while at the place from which they ſet out. So, if there were two earths revolving equably on their axes, and if one remained at *A* until the other travelled round the ſun from *A* to *A* again, *that* earth which kept its place at *A* would have its ſolar and ſyderial days always of the ſame length; and ſo would have one ſolar day more than the other at its return. Hence, if the earth turned but once round its axis in a year, and if that turn was made the ſame way as the earth goes round the ſun, there would be continual day on one ſide of the earth, and continual night on the other.

CHAP. XI. *Of the Equation of Time.*

THE earth's motion on its axis being perfectly uniform, and equal at all times of the year, the ſydereal days are always preciſely of an equal length; and ſo would the ſolar or natural days be, if the earth's orbit were a perfect circle, and its axis perpendicular to its orbit. But the earth's diurnal motion on an inclined axis, and its annual motion in an elliptic orbit, cauſe the ſuns apparent motion in the heavens to be unequal: For ſometimes he revolves from the meridian to the meridian again in ſomewhat leſs than 24 hours, ſhewn by a well-regulated clock; and at other times in ſomewhat more: So that the time ſhewn by an equal going clock and a true ſun-dial is never the ſame but on the 15th of April, the 16th of June, the 31ſt of Auguſt, and the 24th of December. The clock, if it goes equally and true all the year round, will be before the ſun from the 24th of December till the 15th of April; from that time till the 16th of June the ſun will be before the clock; from the 16th of June till the 31ſt of Auguſt, the clock will be again before the ſun; and from thence to the 24th of December the ſun will be faſter than the clock.

The eaſieſt and moſt expeditious way of drawing a meridian line is this: Make four or five concentric circles, about a quarter of an inch from one another, on a flat board, about a foot in breadth; and let the outmoſt circle be but little leſs than the board will contain. Fix a pin perpendicularly in the centre, and of ſuch a length that its whole ſhadow may fall within the innermoſt circle, for at leaſt four hours in the middle of the day. The pin ought to be about an eighth part of an inch thick, and to have a round blunt point. The board being ſet exactly level in a place where the ſun ſhines, ſuppoſe from eight in the morning till four in the afternoon, about which hours the end of the ſhadow ſhould fall without all the circles; watch the times in the forenoon, when the extremity of the ſhortening ſhadow juſt touches the ſeveral circles, and *there* make marks. Then, in the afternoon of the ſame day, watch the lengthening ſhadow, and where its end touches the ſeveral circles in going over them, make marks alſo. Laſtly, with a pair of compaſſes, find exactly the middle point between the two marks on any circle, and draw a ſtraight line from the centre to that point; which line will be covered at noon by the ſhadow of a ſmall upright wire, which ſhould be put in the place of the pin. The reaſon for drawing ſeveral circles is, that in caſe one part of the day ſhould prove clear, and the other part ſomewhat cloudy, if you miſs the time when the point of the ſhadow ſhould touch one circle, you may perhaps catch it in touching another. The beſt time for drawing a meridian line, in this manner, is about the ſummer ſolſtice; becauſe the ſun changes his declination ſloweſt, and his altitude faſteſt in the longeſt days.

If the caſement of a window, on which the ſun ſhines at noon, be quite upright, you may draw a line along the edge of its ſhadow on the floor, when the ſhadow of the pin is exactly on the meridian line of the board; and as the motion of the ſhadow of the caſement will be much more ſenſible on the floor, than that of the ſhadow of the pin on the board, you may know to a few ſeconds when it touches the meridian line on the floor; and ſo regulate your clock for the day of obſervation by that line and any good equation table.

As the equation of time, or difference between the time ſhewn by a well-regulated clock and a true ſun-dial, depends upon two cauſes, namely, the obliquity of the ecliptic, and the unequal motion of the earth in it, we ſhall firſt explain the effects of theſe cauſes ſeparately conſidered, and then the united effects reſulting from their combination.

The earth's motion on its axis being perfectly equable, or always at the ſame rate, and the plane of the equator being perpendicular to its axis, it is evident, that in equal times equal portions of the equator paſs over the meridian; and ſo would equal portions of the ecliptic, if it were parallel to or coincident with the equator. But, as the ecliptic is oblique to the equator, the equable motion of the earth carries unequal portions of the ecliptic over the meridian in equal times, the difference being proportionate to the obliquity; and, as ſome parts of the ecliptic are much more oblique than others, thoſe differences are unequal among themſelves. Therefore, if two ſuns ſhould ſtart either from the beginning of Aries or Libra, and continue to move through equal arcs in equal times, one in the equator, and the other in the ecliptic, the equatoreal ſun would always run to the meridian in 24 hours time, as meaſured by a well-regulated clock; but the ſun in the ecliptic would return to the meridian ſometimes ſooner, and ſometimes later than the equatoreal ſun; and only at the ſame moments with him on four days of the year; namely, the 20th of March, when the ſun enters Aries; the 21ſt of June, when he enters Cancer; the 23d of September, when he enters

enters Libra; and the 21ſt of December, when he enters Capricorn. But, as there is only one ſun, and his apparent motion is always on the ecliptic, let us henceforth call him the *real ſun;* and the other, which is ſuppoſed to move in the equator, the *fictitious;* to which laſt, the motion of a well-regulated clock always anſwers.

In Plate XLII. fig. 4. let Z♈z♎ be the earth, *ZFRz* its axis, *abcde &c.* the equator, *ABCDE &c.* the northern half of the ecliptic from ♈ or ♎ on the ſide of the globe next the eye; and *MNOP* &c. the ſouthern half on the oppoſite ſide from ♎ to ♈. Let the points at *ABCDEF* &c. quite round from ♈ to ♈ again bound equal portions of the ecliptic, gone through in equal times by the real ſun; and thoſe at *abcdef &c.* equal portions of the equator, deſcribed in equal times by the fictitious ſun; and let Z♈z be the meridian.

As the real ſun moves obliquely in the ecliptic, and the fictitious ſun directly in the equator, with reſpect to the meridian; a degree, or any number of degrees, between ♈ and *F* on the ecliptic, muſt be nearer the meridian Z♈z; than a degree, or any correſponding number of degrees on the equator from ♈ to *f*; and the more ſo, as they are the more oblique: And therefore the true ſun comes ſooner to the meridian every day whilſt he is in the quadrant ♈ *F*, than the fictitious ſun does in the quadrant ♈ *f*; for which reaſon, the ſolar noon precedes noon by the clock, until the real ſun comes to *F*, and the fictitious to *f*; which two points, being equidiſtant from the meridian, both ſuns will come to it preciſely at noon by the clock.

Whilſt the real ſun deſcribes the ſecond quadrant of the ecliptic *FGHIKL* from *F* to ♎, he comes later to the meridian every day, than the fictitious ſun moving through the ſecond quadrant of the equator from *f* to ♎; for the points at *GHIK* and *L*, being farther from the meridian than their correſponding points at *ghik* and *l*, they muſt be later of coming to it: And as both ſuns come at the ſame moment to the point ♎, they come to the meridian at the moment of noon by the clock.

In departing from Libra, through the third quadrants, the real ſun going through *MNOPQ* towards *rs* at *R*, and the fictitious ſun through *mnopq* towards *r*, the former comes to the meridian every day ſooner than the latter, until the real ſun comes to *rs*, and the fictitious to *r*, and then they both come to the meridian at the ſame time.

Laſtly, as the real ſun moves equably through *STUVW*, from *rs* towards ♈; and the fictitious ſun thro' *stuvw*, from *r* towards ♈; the former comes later every day to the meridian than the latter, until they both arrive at the point ♈, and then they make noon at the ſame time with the clock.

This part of the equation of time may perhaps be ſomewhat difficult to underſtand by a figure, becauſe both halves of the ecliptic ſeem to be on the ſame ſide of the globe; but it may be made very eaſy to any perſon who has a real globe before him, by putting ſmall patches on every tenth or fifteenth degree, both of the equator and ecliptic, beginning at Aries ♈; and then, turning the ball ſlowly round weſtward, he will ſee all the patches from Aries to Cancer come to the brazen meridian ſooner than the correſponding patches on the equator; all thoſe from Cancer to Libra will come latter to the meridian than their correſponding patches on the equator; thoſe from Libra to Capricorn ſooner, and thoſe from Capricorn to Aries latter: And the patches at the beginnings of Aries, Cancer, Libra, and Capricorn, being either on, or even with thoſe on the equator, ſhew that the two ſuns either meet there, or are even with one another, and ſo come to the meridian at the ſame moment.

Let us ſuppoſe that there are two little balls moving equably round a celeſtial globe by clock-work, one always keeping in the ecliptic, and gilt with gold, to repreſent the real ſun; and the other keeping in the equator, and ſilvered, to repreſent the fictitious ſun: And that whilſt theſe balls move once round the globe, according to the order of ſigns, the clock turns the globe 366 times round its axis weſtward. The ſtars will make 366 diurnal revolutions from the braſen meridian to it again; and the two balls repreſenting the real and fictitious ſun always going farther eaſtward from any given ſtar, will come later than it to the meridian every following day; and each ball will make 365 revolutions to the meridian; coming equally to it at the beginnings of Aries, Cancer, Libra, and Capricorn: But in every other point of the ecliptic, the gilt ball will come either ſooner or latter to the meridian than the ſilver ball, like the patches above mentioned.

This would be a pretty enough way of ſhewing the reaſon why any given ſtar, which, on a certain day of the year, comes to the meridian with the ſun, paſſes over it ſo much ſooner every following day, as on that day twelvemonth to come to the meridian with the ſun again; and alſo to ſhew the reaſon why the real ſun comes to the meridian ſometimes ſooner, ſometimes later, than it is noon by the clock; and, on four days of the year, at the ſame time; whilſt the fictitious ſun always comes to the meridian when it is twelve at noon by the clock. This would be no difficult taſk for an artiſt to perform; for the gold ball might be carried round the ecliptic by a wire from its north pole, and the ſilver ball round the equator by a wire from its ſouth pole, by mean of a few wheels to each.

It is plain, that if the ecliptic were more obliquely poſited to the equator, as the doted circle ♈♓♎, the equal diviſions from ♈ to ♓ would come ſtill ſooner to the meridian Zo♈ than thoſe marked *ABCD* and *E* do; for two diviſions containing 30 degrees, from ♈ to the ſecond dot, a little ſhort of the figure 1, come ſooner to the meridian than one diviſion containing only 15 degrees from ♈ to *A* does, as the ecliptic now ſtands: and thoſe of the ſecond quadrant from ♓ to ♎ would be ſo much later. The third quadrant would be as the firſt, and the fourth as the ſecond. And it is likewiſe plain, that where the ecliptic is moſt oblique, namely, about Aries and Libra, the difference would be greateſt; and leaſt about Cancer and Capricorn, where the obliquity is leaſt.

Having explained one cauſe of the difference of time ſhewn by a well-regulated clock and a true ſun-dial; and conſidered the ſun, not the earth, as moving in the ecliptic

Fig. 1.

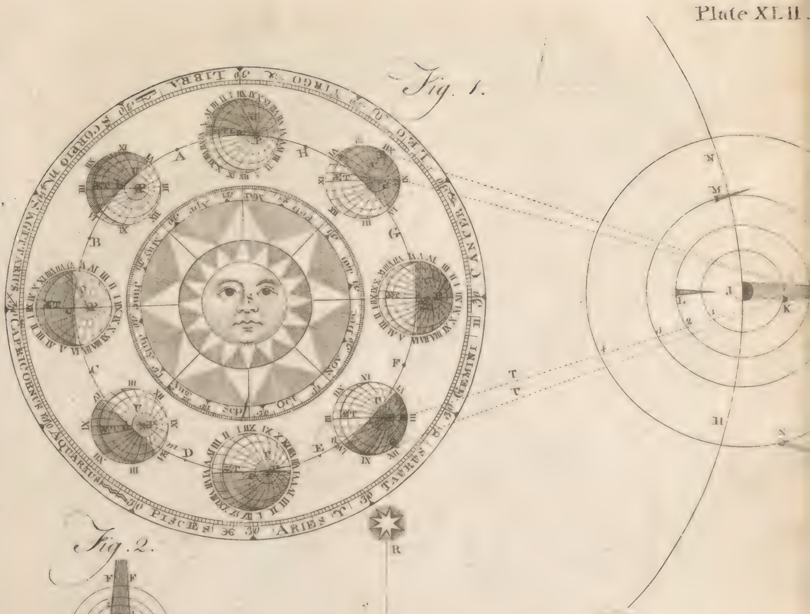


Fig. 2.

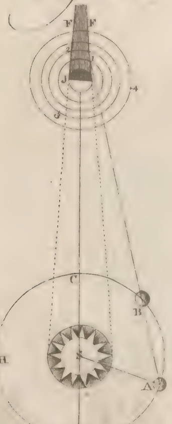
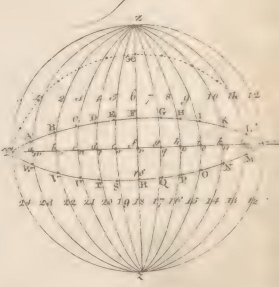


Fig. 3.

Fig. 4.



ecliptic: We now proceed to explain the other cause of this difference, namely, the inequality of the ſun's apparent motion, which is ſloweſt in the ſummer, when the the ſun is fartheſt from the earth, and ſwifteſt in winter when he is neareſt to it. But the earth's motion on its axis is equable all the year round, and is performed from weſt to eaſt; which is the way that the ſun appears to change his place in the ecliptic.

If the ſun's motion were equable in the ecliptic, the whole difference, between the equal time as ſhewn by a clock, and the unequal time as ſhewn by the ſun, would ariſe from the obliquity of the ecliptic. But the ſun's motion ſometimes exceeds a degree in 24 hours, though generally it is leſs: And when his motion is ſloweſt, any particular meridian will revolve ſooner to him than when his motion is quickeſt; for it will overtake him in leſs time when he advances a leſs ſpace than when he moves through a larger.

Now, if there were two ſuns moving in the plane of the ecliptic, ſo as to go round it in a year; the one deſcribing an equal arc every 24 hours, and the other deſcribing ſometimes a leſs arc 24 hours, and at other times a larger, gaining at one time of the year what it loſt at the oppoſite; it is evident that either of theſe ſuns would come ſooner or latter to the meridian than the other, as it happened to be behind or before the other: and when they were both in conjunction, they would come to the meridian at the ſame moment.

As the real ſun moves unequably in the ecliptic, let us ſuppoſe a fictitious ſun to move equably in a circle coincident with the plane of the ecliptic. In Plate XLIII. fig. 1. let *ABCD* be the ecliptic or orbit in which the real ſun moves, and the doted circle *abcd* the imaginary orbit of the fictitious ſun; each going round in a year according to the order of letters, or from weſt to eaſt. Let *HIKL* be the earth turning round its axis the ſame way every 24 hours; and ſuppoſe both ſuns to ſtart from *A* and *a*, in a right line with the plane of the meridian *EH*, at the ſame moment; the real ſun at *A* being then at his greateſt diſtance from the earth, at which time his motion is ſloweſt; and the fictitious ſun at *a*, whoſe motion is always equable, becauſe his diſtance from the earth is ſuppoſed to be always the ſame. In the time that the meridian revolves from *H* to *H* again, according to the order of the letters *HIKL*, the real ſun has moved from *A* to *F*; and the fictitious with a quicker motion from *a* to *f*, through a larger arc. Therefore, the meridian *EH* will revolve ſooner from *H* to *h* under the real ſun at *F*, than from *H* to *k* under the fictitious ſun at *f*; and conſequently it will then be noon by the ſun-dial ſooner than by the clock.

As the real ſun moves from *A* towards *C*, the ſwiftneſs of his motion increaſes all the way to *C*, where it is at the quickeſt. But notwithſtanding this, the fictitious ſun gains ſo much upon the real, ſoon after his departing from *A*, that the increaſing velocity of the real ſun does not bring him up with the equally moving fictitious ſun till the former comes to *C*, and the latter to *c*, when each has gone half round its reſpective orbit; and then being in conjunction, the meridian *EH* relvolving to *EK* comes to both ſuns at the ſame time, and therefore it is noon by them both at the ſame moment.

But the increaſing velocity of the real ſun, now being at the quickeſt, carries him before the fictitious one; and therefore, the ſame meridian will come to the fictitious ſun ſooner than to the real: For, whilſt the fictitious ſun moves from *c* to *g*, the real ſun moves through a greater arc from *C* to *G*; conſequently the point *K* has its noon by the clock when it comes to *k*, but not its noon by the ſun till it come to *l*. And although the velocity of the real ſun diminiſhes all the way from *C* to *A*, and the fictitious ſun by an equable motion is ſtill coming nearer to the real ſun, yet they are not in conjunction till the one comes to *A* and the other to *a*; and then it is noon by them both at the ſame moment.

Thus it appears, that the ſolar noon is always later than noon by the clock, whilſt the ſun goes from *C* to *A*; ſooner whilſt he goes from *A* to *C*; and at theſe points the ſun and clock being equal, it is noon by them both at the ſame moment.

The point *A* is called the ſun's *apogee*, becauſe when he is there he is at his greateſt diſtance from the earth; the point *C* his *perigee*, becauſe when in it he is at his leaſt diſtance from the earth; and a right line, as *AEC*, drawn through the earth's centre, from one of theſe points to the other, is called *the line of the apſides*.

The diſtance that the ſun has gone in any time from his apogee (not the diſtance he has to go to it, though ever ſo little) is called his *mean anomaly*, and is reckoned in ſigns and degrees, allowing 30 degrees to a ſign. Thus, when the ſun has gone, ſuppoſe 174 degrees from his apogee at *A*, he is ſaid to be 5 ſigns 24 degrees from it, which is his mean anomaly: And when he is gone, ſuppoſe 355 degrees from his apogee, he is ſaid to be 11 ſigns 25 degrees from it, although he be but 5 degrees ſhort of *A* in coming round to it again.

From what was ſaid above, it appears, than when the ſun's anomaly is leſs than 6 ſigns, that is, when he is any where between *A* and *C*, in the half *ABC* of his orbit, the ſolar noon precedes the clock noon; but when his anomaly is more than 6 ſigns, that is, when he is any where between *C* and *A*, in the half *CDA* of his orbit, the clock noon precedes the ſolar. When his anomaly is 0 ſigns 0 degrees, that is, when he is in his apogee at *A*; or 6 ſigns 0 degrees, which is when he is in his perigee at *C*; he comes to the meridian at the moment that the fictitious ſun does, and then it is noon by them both at the ſame inſtant.

The obliquity of the ecliptic to the equator, which is the firſt mentioned cauſe of the equation of time, would make the ſun and clocks agree on four days of the year; which are, when the ſun enters Aries, Cancer, Libra, and Capricorn: But the other cauſe, now explained, would make the ſun and clocks equal only twice a year; that is, when the ſun is in his apogee and perigee. Conſequently, when theſe two points fall in the beginnings of Cancer and Capricorn, or of Aries and Libra, they concur in making the ſun and clocks equal in theſe points. But the apogee at preſent is in the 9th degree of Cancer, and

and the perigee in the 9th degree of Capricorn, and therefore the ſun and clocks cannot be equal about the beginning of theſe ſigns, nor at any time of the year, except when the ſwiftneſs or ſlowneſs of equation reſulting from one cauſe juſt balances the ſlowneſs or ſwiftneſs ariſing from the other.

Chap. XII. *Of the Preceſſion of the Equinoxes.*

It is a known fact, that there is a greater quantity of matter accumulated all round the equatoreal parts of the earth than any where elſe.

The ſun and moon, by attracting this redundancy of matter, bring the equator ſooner under them in every return towards it, than if there was no ſuch accumulation. Therefore, if the ſun ſets out, as from any ſtar, or other fixed point in the heavens, the moment when he is departing from the equinoctial or from either tropic, he will come to the ſame equinox or tropic again 20 min. $17\frac{1}{2}$ ſec. of time, or 50 ſeconds of a degree, before he completes his courſe, ſo as to arrive at the ſame fixed ſtar or point from whence he ſet out. For, the equinoctial points recede 50 ſeconds of a degree weſtward every year, contrary to the ſun's annual progreſſive motion.

When the ſun arrives at the ſame equinoctial or ſolſtitial point, he finiſhes what we call the ***tropical year***; which, by obſervation, is found to contain 365 days 5 hours 48 minutes 57 ſeconds: And, when he arrives at the ſame fixed ſtar again, as ſeen from the earth, he completes the *ſydereal year*, which contains 365 days 6 hours 9 minutes $14\frac{1}{2}$ ſeconds. The ſydereal year is therefore 20 minutes $17\frac{1}{2}$ ſeconds longer than the ſolar or tropical year; and 9 minutes $14\frac{1}{2}$ ſeconds longer than the Julian or civil year, which we ſtate at 365 days 6 hours: So that the civil year is almoſt a mean betwixt the ſydereal and tropical.

As the ſun deſcribes the whole ecliptic, or 360 degrees, in a tropical year, he moves 59 minutes 8 ſeconds of a degree every day at a mean rate; and conſequently 50 ſeconds of a degree in 20 minutes $17\frac{1}{2}$ ſeconds of time: Therefore, he will arrive at the ſame equinox or ſolſtice when he is 50 ſeconds of a degree ſhort of the ſame ſtar or fixed point in the heavens from which he ſet out in the year before. So that, with reſpect to the fixed ſtars, the ſun and equinoctial points fall back (as it were) 30 degrees in 2160 years; which will make the ſtars appear to have gone 30 degrees forward, with reſpect to the ſigns of the ecliptic in that time: For the ſame ſigns always keep in the ſame points of the ecliptic, without regard to the conſtellations.

To explain this by a figure, (Plate XLIII. fig. 1.) let the ſun be in conjunction with a fixed ſtar at *S*, ſuppoſe in the 30th degree of ♉ on the 21ſt of May 1756. Then, making 2160 revolutions through the ecliptic *VWX*, at the end of ſo many ſydereal years, he will be found again at *S*: But at the end of ſo many Julian years, he will be found at *M*, ſhort of *S*; and at the end of ſo many tropical years, he will be found ſhort of *M* in the 30th degrees of Taurus at *T*, which has receded back from *S* to *T* in that time, by the preceſſion of the equinoctial points ♈ Aries and ♎ Libra. The arc *ST* will be equal to the amount of the preceſſion of the equinox in 2160 years, at the rate of 50 ſeconds of a degree, or 20 minutes $17\frac{1}{2}$ ſeconds of time, annually: This, in ſo many years, makes 30 days $10\frac{1}{2}$ hours; which is the difference between 2160 ſydereal and tropical years: And the arc *MT* will be equal to the ſpace moved through by the ſun in 2160 times 11 minutes 3 ſeconds, or 16 days 13 hours 48 minutes, which is the difference between 2160 Julian and tropical years.

A

A TABLE *shewing the Precession of the Equinoctial Points in the Heavens, both in Motion and Time; and the Anticipation of the Equinoxes on Earth.*

Julian years.	Procession of the Equinoxial Points in the Heavens.								Anticipation of the Equinoxes on the Earth.			
	Motion.				Time.							
	s	°	′	″	Days.	H.	M.	S.	D.	H.	M.	S.
1	0	0	0	50	0	0	20	17½	0	0	11	3
2	0	0	1	40	0	0	40	35	0	0	22	6
3	0	0	2	30	0	1	0	52½	0	0	33	9
4	0	0	3	20	0	1	21	10	0	0	44	12
5	0	0	4	10	0	1	41	27½	0	0	55	15
6	0	0	5	0	0	2	1	45	0	1	6	18
7	0	0	5	50	0	2	22	2½	0	1	17	21
8	0	0	6	40	0	2	42	20	0	1	28	24
9	0	0	7	30	0	3	2	37½	0	1	39	27
10	0	0	8	20	0	3	22	55	0	1	50	30
20	0	0	16	40	0	6	45	50	0	3	41	0
30	0	0	25	0	0	10	8	45	0	5	31	30
40	0	0	33	20	0	13	31	40	0	7	22	0
50	0	0	41	40	0	16	54	35	0	9	12	30
60	0	0	50	0	0	20	17	30	0	11	3	0
70	0	0	58	20	0	23	40	25	0	12	53	30
80	0	1	6	40	1	3	3	20	0	14	44	0
90	0	1	15	0	1	6	26	15	0	16	34	30
100	0	1	23	20	1	9	49	10	0	18	25	0
200	0	2	46	40	2	19	38	20	1	12	50	0
300	0	4	10	0	4	5	27	30	2	7	15	0
400	0	5	33	20	5	15	16	40	3	1	40	0
500	0	6	56	40	7	1	5	50	3	20	5	0
600	0	8	20	0	8	10	55	0	4	14	30	0
700	0	9	43	20	9	20	44	10	5	8	55	0
800	0	11	6	40	11	6	33	20	6	3	20	0
900	0	12	30	0	12	16	22	30	6	21	45	0
1000	0	13	53	20	14	2	11	40	7	16	10	0
2000	0	27	46	40	28	4	23	20	15	8	20	0
3000	1	11	40	0	42	6	35	0	23	0	30	0
4000	1	25	33	20	56	8	46	40	30	16	40	0
5000	2	9	26	40	70	10	58	20	38	8	50	0
6000	2	23	20	0	84	13	10	0	46	1	0	0
7000	3	7	13	20	98	15	21	40	53	17	10	0
8000	3	21	6	40	112	17	33	20	61	9	20	0
9000	4	5	0	0	126	19	45	0	69	1	30	0
10000	4	18	53	20	140	21	56	40	76	17	40	0
20000	9	7	46	40	281	19	53	20	153	11	20	0
25920	12	0	0	0	365	6	0	0	198	21	36	0

From

From the ſhifting of the equinoctial points, and with them all the ſigns of the ecliptic, it follows, that thoſe ſtars which, in the infancy of aſtronomy, were in Aries, are now got into Taurus; thoſe of Taurus into Gemini, *&c.* Hence likewiſe it is, that the ſtars which roſe or ſet at any particular ſeaſon of the year, in the times of Heſiod, Eudoxius, Virgil, Pliny, *&c.* by no means anſwer at this time to their deſcriptions. The preceding table ſhews the quantity of this ſhifting both in the heavens and on the earth, for any nnmber of years to 25,920, which compleats the grand celeſtial period; within which any number and its quantity is eaſily found, as in the following example, for 5763 years; which, at the autumnal equinox, *A. D.* 1756, is thought to be the age of the world. So that with regard to the fixed ſtars, the equinoctial points in the heavens have receded $2^s\ 20^\circ\ 2'\ 30''$ ſince the creation; which is as much as the ſun moves in $81^d\ 5^h\ 0^m\ 52^s$. And ſince that time, or in 5763 years, the equinoxes with us have fallen back $44^d\ 5^h\ 21^m\ 9^s$; hence, reckoning from the time of the Julian equinox, *A. D.* 1756, *viz.* Sept. 11th, it appears, that the autumnal equinox at the creation was on the 25th of October.

Julian years.	Preceſſion of the Equinoctial Points in the Heavens.								Anticipation of the Equinoxes on the Earth.			
	Motion.				Time.							
	s	o	′	″	D.	H.	M.	S.	D.	H.	M.	S.
5000	2	9	26	40	70	10	58	20	38	8	50	0
700	0	9	43	20	9	20	44	10	5	8	55	0
60	0	0	50	0	0	20	17	30	0	11	3	0
3	0	0	2	30	0	1	0	52	0	0	33	9
5763	2	20	2	30	81	5	0	52	44	5	21	9

The anticipation of the equinoxes, and conſequently of the ſeaſons, is by no means owing to the preceſſion of the equinoctial and ſolſtitial points in the heavens, (which can only affect the apparent motions, places, and declinations of the fixed ſtars), but to the difference between the civil and ſolar year, which is 11 minutes 3 ſeconds; the civil year containing 365 days 6 hours, and the ſolar year 365 days 5 hours 48 minutes 57 ſeconds.

The above 11 minutes 3 ſeconds, by which the civil or Julian year exceeds the ſolar, amounts to 11 days in 1433 years; and ſo much our ſeaſons have fallen back with reſpect to the days of the months, ſince the time of the Nicene Council in *A. D.* 325, and therefore in order to bring back all the faſts and feſtivals to the days then ſettled, it was requiſite to ſuppreſs 11 nominal days. And that the ſame ſeaſons might be kept to the ſame times of the year for the future, to leave out the biſſextile day in February at the end of every century of years not diviſible by 4; reckoning them only common years, as the 17th, 18th, and 19th centuries, *viz.* the years 1700, 1800, 1900, *&c.* becauſe a day intercalated every fourth year was too much, and retaining the biſſextile-day at the end of thoſe centuries of years which are diviſible by 4, as the 16th, 20th, and 24th centuries, *viz.* the years 1600, 2000, 2400, *&c.* Otherwiſe, in length of time, the ſeaſons would be quite reverſed with regard to the months of the year; though it would have required near 23,783 years to have brought about ſuch a total change. If the earth had made exactly $365\frac{1}{4}$ diurnal rotations on its axis, whilſt it revolved from any equinoctial or ſolſtitial point to the ſame again, the civil and ſolar years would always have kept pace together, and the ſtyle would never have needed any alteration.

Having already mentioned the cauſe of the preceſſion of the equinoctial points in the heavens, which occaſions a ſlow deviation of the earth's axis from its paralleliſm, and thereby a change of the declination of the ſtars from the equator, together with a ſlow apparent motion of the ſtars forward with reſpect to the ſigns of the ecliptic; we ſhall now deſcribe the phenomena by a diagram.

In Plate XLIII. fig. 2. let *NZSVL* be the earth, *SONA* its axis produced to the ſtarry heavens, and terminating in *A*, the preſent north pole of the heavens, which is vertical to *N* the north pole of the earth. Let *EO♎* be the equator, *T♋Z* the tropic of Cancer, and *VTr* the tropic of Capricorn; *VOZ* the ecliptic, and *BO* its axis, both which are immoveable among the ſtars. But as the equinoctial points recede in the ecliptic, the earth's axis *SON* is in motion upon the earth's centre *O*, in ſuch a manner as to deſcribe the double cone *NOn* and and *SOs*, round the axis of the ecliptic *BO*, in the time that the equinoctial points move quite round the ecliptic, which is 25,920 years; and in that length of time, the north pole of the earth's axis produced, deſcribes the circle *ABCDA* in the ſtarry heavens, round the pole of the ecliptic, which keeps immoveable in the centre of that circle. The earth's axis being $23\frac{1}{2}$ degrees inclined to the axis of the ecliptic, the circle *ADCDA*, deſcribed by the north pole of the earth's axis produced to *A*, is 47 degrees in diameter, or double the inclination of the earth's axis. In conſequence of this, the point *A*, which at preſent is the north pole of the heavens, and near to a ſtar of the ſecond magnitude in the tail of the conſtellation called the *Little Bear*, muſt be deſerted by the earth's axis, which moving backwards a degree every 72 years, will be directed towards the ſtar or point *B* in 6480

6480 years hence; and in double of that time, or 12,960 years, it will be directed towards the ſtar or point C; which will then be the north pole of the heavens, although it is at preſent $8\frac{1}{2}$ degrees ſouth of the zenith of London L. The preſent poſition of the equator $EO♋$, will then be changed into eOq; the tropic of Cancer $T♋Z$, into $Vt♋$; and the tropic of Capricorn $VTrs$, into $trsZ$; as is evident by the figure. And the ſun, in the ſame part of the heavens where he is now over the earthly tropic of Capricorn, and makes the ſhorteſt days and longeſt nights in the northern hemiſphere, will then be over the earthly tropic of Cancer, and make the days longeſt and nights ſhorteſt. So that it will require 12,960 years yet more, or 25,920 from the preſent time, to bring the north pole N quite round, ſo as to be directed towards that point of the heavens which is vertical to it at preſent. And then, and not till then, the ſame ſtars which at preſent deſcribe the equator, tropics, and polar circles, &c. by the earth's diurnal motion, will deſcribe them over again.

CHAP. XIII. *The moon's ſurface mountainous: Her phaſes deſcribed: Her path and the paths of Jupiter's moons delineated: The proportions of the diameters of their orbits, and thoſe of Saturn's moons, to each other, and to the diameter of the Sun.*

BY looking at the moon with an ordinary teleſcope, we perceive that her ſurface is diverſified with long tracts of prodigious high mountains and deep cavities. Some of her mountains, by comparing their height with her diameter (which is 2180 miles) are found to be three times higher than the higheſt hills on our earth. This ruggedneſs of the moon's ſurface is of great uſe to us, by reflecting the ſun's light to all ſides; for if the moon were ſmooth and poliſhed like a looking-glaſs, or covered with water, ſhe could never diſtribute the ſun's light all round; only in ſome poſitions ſhe would ſhew us his image no bigger than a point, but with ſuch a luſtre as would be hurtful to our eyes.

The moon's ſurface being ſo uneven, many have wondered why her edge appears not jagged, as well as the curve bounding the light and dark places. But if we conſider, that what we call the edge of the moon's diſk is not a ſingle line ſet round with mountains, in which caſe it would appear irregularly indented, but a large zone having many mountains lying behind one another from the obſerver's eye, we ſhall find that the mountains in ſome rows will be oppoſite to the vales in others, and ſo fill up the inequalities as to make her appear quite round; juſt as when one looks at an orange, although its roughneſs be very diſcernible on the ſide next the eye, eſpecially if the ſun or a candle ſhines obliquely on that ſide, yet the line terminating the viſible part ſtill appears ſmooth and even.

As the ſun can only enlighten that half of the earth which is at any moment turned towards him, and being withdrawn from the oppoſite half, leaves it in darkneſs; ſo he likewiſe doth to the moon; only with this difference, that the earth being ſurrounded by an atmoſphere, and the moon having none, we have twilight after the ſun ſets; but the lunar inhabitants have an immediate tranſition from the brighteſt ſun-ſhine to the blackeſt darkneſs. For, (Plate XLIII. fig. 3.) let $tkrsw$ be the earth, and $ABCDEFGH$ the moon in eight different parts of her orbit. As the earth turns round its axis from weſt to eaſt, when any place comes to t the twilight begins there, and when it revolves from thence to r the the ſun S riſes; when the place comes to s the ſun ſets, and when it comes to w the twilight ends. But as the moon turns round her axis, which is only once a-month, the moment that any point of her ſurface comes to r (ſee the moon at G) the ſun riſes there without any previous warning by twilight; and when the ſame point comes to s the ſun ſets, and that point goes into darkneſs as black as at midnight.

The moon being an opaque ſpherical body, (for her hills take off no more from her roundneſs than the inequalities on the ſurface of an orange takes off from its roundneſs), we can only ſee that part of the enlightened half of her which is towards the earth. And therefore, when the moon is at A, in conjunction with the ſun S, her dark half is towards the earth, and ſhe diſappears, as at a, there being no light on that half to render it viſible. When ſhe comes to her firſt octant at B, or has gone an eighth part of her orbit from her conjunction, a quarter of her enlightened ſide is towards the earth, and ſhe appears horned, as at b. When ſhe has gone a quarter of her orbit from between the earth and ſun to C, ſhe ſhews us one half of her enlightened ſide, as at c, and we ſay, ſhe is a quarter old. At D in her ſecond octant, and by ſhewing us more of her enlightened ſide ſhe appears gibbous, as at d. At E her whole enlightened ſide is towards the earth, and therefore ſhe appears round, as at e, when we ſay, it is full moon. In her third octant at F, part of her dark ſide being towards the earth, ſhe again appears gibbous, and is on the decreaſe, as at f. At G we ſee juſt one half of her enlightened ſide, and ſhe appears half decreaſed, or in her third quarter, as at g. At H we only ſee a quarter of her enlightened ſide, being in her fourth octant, where ſhe appears horned, as at h. And at A, having compleated her courſe from the ſun to the ſun again, ſhe diſappears, and we ſay, it is new moon. Thus in going from A to E, the moon ſeems continually to increaſe; and in going from E to A, to decreaſe in the ſame proportion; having like phaſes at equal diſtances from A or E, but as ſeen from the ſun S, ſhe is always full.

The moon appears not perfectly round when ſhe is full in the higheſt or loweſt part of her orbit, becauſe we have not a full view of her enlightened ſide at that time. When full in the higheſt part of her orbit, a ſmall deficiency appears on her lower edge; and the contrary when full in the loweſt part of her orbit.

It is plain by the figure, that when the moon changes to the earth, the earth appears full to the moon; and *vice verſa*. For when the moon is at A, new to the earth, the whole enlightened ſide of the earth is towards the moon; and when the moon is at E, full to the earth, its

its dark ſide is towards her. Hence a new moon anſwers to a full earth, and a full moon to a new earth. The quarters are alſo reverſed to each other.

Between the third quarter and change, the moon is frequently viſible in the forenoon, even when the ſun ſhines; and then ſhe affords us an opportunity of ſeeing a very agreeable appearance, where-ever we find a globular ſtone above the level of the eye, as ſuppoſe on the top of a gate. For, if the ſun ſhines on the ſtone, and we place ourſelves ſo as the upper part of the ſun may juſt ſeem to touch the point of the moon's lowermoſt horn, we ſhall then ſee the enlightened part of the ſtone exactly of the ſame ſhape with the moon, horned as ſhe is, and inclining the ſame way to the horizon. The reaſon is plain, for the ſun enlightens the ſtone the ſame way as he does the moon; and both being globes, when we put ourſelves into the above ſituation, the moon and ſtone have the ſame poſition to our eyes, and therefore we muſt ſee as much of the illuminated part of the one as of the other.

The poſition of the moon's cuſps, or a right line touching the points of her horns, is very differently inclined to the horizon at different hours of the ſame days of her age. Sometimes ſhe ſtands, as it were, upright on her lower horn, and then ſuch a line is perpendicular to the horizon: when this happens, ſhe is in what the aſtronomers call the *nonageſimal degree*, which is the higheſt point of the ecliptic above the horizon at that time, and is 90 degrees from both ſides of the horizon, where it is then cut by the ecliptic. But this never happens when the moon is on the meridian, except when ſhe is at the very beginning of Cancer or Capricorn.

The inclination of that part of the ecliptic to the horizon in which the moon is at any time when horned, may be known by the poſition of her horns; for a right line touching their points is perpendicular to the ecliptic. And as the angle that the moon's orbit makes with the ecliptic can never raiſe her above, nor depreſs her below the ecliptic, more than two minutes of a degree, as ſeen from the ſun, it can have no ſenſible effect upon the poſition of her horns. Therefore, if a quadrant be held up, ſo as one of its edges may ſeem to touch the moon's horns, the graduated ſide being kept towards the eye, and as far from the eye as it can be conveniently held, the arc between the plumb-line and that edge of the quadrant which ſeems to touch the moon's horns, will ſhew the inclination of that part of the ecliptic to the horizon. And the arc between the other edge of the quadrant and plumb-line will ſhew the inclination of the moon's horns to the horizon.

The moon generally appears as large as the ſun; for the angle *vkA*, (Plate XLIII. fig. 3.) under which the moon is ſeen from the earth, is the ſame with the angle *LkM*, under which the ſun is ſeen from it. And therefore the moon may hide the ſun's whole diſk from us, as ſhe ſometimes does in ſolar eclipſes. The reaſon why ſhe does not eclipſe the ſun at every change ſhall be explained afterwards. If the moon were farther from the earth, as at *a*, ſhe could never hide the whole of the ſun from us; for then ſhe would appear under the angle *NkO*, eclipſing only that part of the ſun which lies between *N* and *O*: were ſhe ſtill further from the earth, as at *X*, ſhe would appear under the ſmall angle *TkW*, like a ſpot on the ſun, hiding only the part *TW* from our ſight.

The moon turns round her axis in the time that ſhe goes round her orbit; which is evident from hence, that a ſpectator at reſt, without the periphery of the moon's orbit, would ſee all her ſides turned regularly towards him in that time. She turns round her axis from any ſtar to the ſame ſtar again in 27 days 8 hours; from the ſun to the ſun again in 29½ days: the former is the length of the ſydereal day, and the latter the length of her ſolar day. A body moving round the ſun would have a ſolar day in every revolution, without turning on its axis, the ſame as if it had kept all the while at reſt, and the ſun moved round it; but without turning round its axis it could never have one ſydereal day, becauſe it would always keep the ſame ſide towards any given ſtar.

If the earth had no annual motion, the moon would go round it ſo as to compleat a lunation, a ſydereal, and a ſolar day, all in the ſame time. But, becauſe the earth goes forward in its orbit, while the moon goes round the earth in her orbit, the moon muſt go as much more than round her orbit from change to change in compleating a ſolar day, as the earth has gone forward in its orbit during that time, *i. e.* almoſt a twelfth part of a circle.

The moon's periodical and ſynodical revolution may be familiarly repreſented by the motions of the hour and minute-hands of a watch round its dial-plate, which is divided into 12 equal parts or hours, as the ecliptic is divided into 12 ſigns, and the year into 12 months. Let us ſuppoſe theſe 12 hours to be 12 ſigns, the hour-hand the ſun, and the minute-hand the moon; then will the former go round once in a year, and the latter once in a month; but the moon, or minute-hand, muſt go more than round from any point of the circle where it was laſt conjoined with the ſun, or hour-hand, to overtake it again: For the hour-hand being in motion, can never be overtaken by the minute-hand at that point from which they ſtarted at their laſt conjunction.

If the earth had no annual motion, the moon's motion round the earth, and her track in abſolute ſpace, would be always the ſame. But as the earth and moon move round the ſun, the moon's real path in the heavens is very different from her viſible path round the earth; the latter being in a progreſſive circle, and the former in a curve of different degrees of concavity, which would always be the ſame in the ſame parts of the heavens, if the moon performed a complete number of lunations in a year without any thing over.

Let a nail in the end of the axle of a chariot-wheel repreſent the earth, and a pin in the nave the moon; if the body of the chariot be propped up ſo as to keep that wheel from touching the ground, and the wheel be then turned round by hand, the pin will deſcribe a circle both round the nail, and in the ſpace it moves through. But if the props be taken away, the horſes put to, and the chariot driven over a piece of ground which is circularly convex, the nail in the axle will deſcribe a circular curve, and the pin in the nave will ſtill deſcribe a circle round the progreſſive nail in the axle, but not in the ſpace through which it moves. In this caſe, the curve deſcribed

described by the nail will resemble in miniature as much of the earth's annual path round the sun, as it describes whilst the moon goes as often round the earth as the pin does round the nail; and the curve described by the nail will have some resemblance of the moon's path during so many lunations.

Let us now suppose that the radius of the circular curve described by the nail in the axle is to the radius of the circle which the pin in the nave describes round the axle, as $337\frac{1}{2}$ to 1; which is the proportion of the radius or semidiameter of the earth's orbit to that of the moon's, or of the circular curve *A* 1 2 3 4 5 6 7 *B*, &c. to the little circle *a*; and then, whilst the progressive nail describes the said curve from *A* to *E*, the pin will go once round the nail with regard to the centre of its path, and in so doing, will describe the curve *abcde*. The former will be a true representation of the earth's path for one lunation, and the latter of the moon's for that time. Here we may set aside the inequalities of the moon's motion, and also the earth's moving round its common centre of gravity and the moon's: All which, if they were truly copied in this experiment, would not sensibly alter the figure of the paths described by the nail and pin, even though they should rub against a plain upright surface all the way, and leave their tracks visible upon it. And if the chariot was driven forward on such a convex piece of ground, so as to turn the wheel several times round, the track of the pin in the nave would still be concave toward the centre of the circular curve described by the pin in the axle; as the moon's path is always concave to the sun in the centre of the earth's annual orbit.

In this diagram, the thickest curve line *ABCD*, with the numeral figures set to it, represents as much of the earth's annual orbit as it describes in 32 days from west to east; the little circles at *abcde* shew the moon's orbit in due proportion to the earth's; and the smallest curve *abcdef* represents the line of the moon's path in the heavens for 32 days, accounted from any particular new moon at *a* The machine, Plate XLIX. fig. 2. is for delineating the moon's path, and will be described, with the rest of the astronomical machinery, in the last chapter. The sun is supposed to be in the centre of the curve *A* 1 2 3 4 5 6 7 *B*, &c. and the small dotted circles upon it represent the moon's orbit, of which the radius is in the same proportion to the earth's path in this scheme, that the radius of the moon's orbit in the heavens bears to the radius of the earth's annual path round the sun; that is, as 240,000 to 81,000,000, or as 1 to $337\frac{1}{2}$.

When the earth is at *A*, the new moon is at *a*; and in the seven days that the earth describes the curve 1 2 3 4 5 6 7, the moon, in accompanying the earth describes the curve *ab*; and is in her first quarter at *b* when the earth is at *B*. As the earth describes the curve *B* 8 9 10 11 12 13 14, the moon describes the curve *bc*; and is at *c*, opposite to the sun, when the earth is at *C*. Whilst the earth describes the curve *C* 15 16 17 18 19 20 21 22, the moon describes the curve *cd*; and is in her third quarter at *d* when the earth is at *D*. Once more, whilst the earth describes the curve *D* 23 24 25 26 27 28 29, the moon describes the curve *de*, and is again in conjunction at *e* with the sun when the earth is at *E*, between the 29th and 30th day of the moon's age, accounted by the numeral figures from the new moon at *A*. In describing the curve *abcde*, the moon goes round the progressive earth as really as if she had kept in the dotted circle *A*, and the earth continued immoveable in the centre of that circle.

And thus we see, that although the moon goes round the earth in a circle, with respect to the earth's centre, her real path in the heavens is not very different in appearance from the earth's path. To shew that the moon's path is concave to the sun, even at the time of change, it is carried on a little farther into a second lunation, as to *f*.

The moon's absolute motion from her change to her first quarter, or from *a* to *b*, is so much slower than the earth's, that she falls 240 thousand miles (equal to the semidiameter of her orbit) behind the earth at her first quarter in *b*, when the earth is in *B*; that is, she falls back a space equal to her distance from the earth. From that time her motion is gradually accelerated to her opposition or full at *c*, and then she is come up as far as the earth, having regained what she lost in her first quarter from *a* to *b*. From the full to the last quarter at *d*, her motion continues accelerated, so as to be just as far before the earth at *D*, as she was behind it at her first quarter in *b*. But, from *d* to *e* her motion is retarded so, that she loses as much with respect to the earth as is equal to her distance from it, or to the semidiameter of her orbit; and by that means she comes to *e*, and is then in conjunction with the sun, as seen from the earth at *E*. Hence we find, that the moon's absolute motion is slower than the earth's from her third quarter to her first; and swifter than the earth's from her first quarter to her third: Her path being less curved than the earth's in the former case, and more in the latter. Yet it is still bent the same way towards the sun; for if we imagine the concavity of the earth's orbit to be measured by the length of a perpendicular line *Cg*, let down from the earth's place upon the straight line *bgd* at the full of the moon, and connecting the places of the earth at the end of the moon's first and third quarters, that length will be about 640 thousand miles; and the moon, when new, only approaching nearer to the sun by 240 thousand miles than the earth is, the length of the perpendicular let down from her place at that time upon the same straight line, and which shews the concavity of that part of her path, will be about 400 thousand miles.

The moon's path being concave to the sun throughout, demonstrates that her gravity towards the sun, at her conjunction, exceeds her gravity towards the earth. And if we consider that the quantity of matter in the sun is almost 230 thousand times as great as the quantity of matter in the earth, and that the attraction of each body diminishes as the square of the distance from it increases, we shall soon find, that the point of equal attraction between the earth and the sun is about 70 thousand miles nearer the earth than the moon is at her change. It may now appear surprising, that the moon does not abandon the earth when she is between it and the sun, because she is considerably more attracted by the sun than by the earth:

earth at that time. But this difficulty vanishes when we consider, that a common impulse on any system of bodies affects not their relative motions; but that they will continue to attract, impel, or circulate round one another, in the same manner as if there was no such impulse. The moon is so near the earth, and both of them so far from the sun, that the attractive power of the sun may be considered as equal on both; and therefore, the moon will continue to circulate round the earth in the same manner as if the sun did not attract them at all; like bodies in the cabbin of a ship, which move round, or impel one another, in the same manner when the ship is under sail, as when it is at rest, because they are all equally affected by the common motion of the ship. If by any other cause, such as the near approach of a comet, the moon's distance from the earth should happen to be so much increased, that the difference of their gravitating forces towards the sun should exceed that of the moon towards the earth; in that case, the moon, when in conjunction, would abandon the earth, and be either drawn into the sun, or comet, or circulate round about it.

The curves which Jupiter's satellites describe, are all of different sorts from the path described by our moon, although these satellites go round Jupiter, as the moon goes round the earth. In Plate XLIII. fig. 3. let *ABCDE*, &c. be as much of Jupiter's orbit as he describes in 18 days from *A* to *T*; and the curves *abcd* will be the paths of his four moons going round him in his progressive motion.

Now let us suppose all these moons to set out from a conjunction with the sun, as seen from Jupiter at *A*; then his first or nearest moon will be at *a*, his second at *b*, his third at *c*, and his fourth at *d*. At the end of 24 terrestrial hours after this conjunction, Jupiter has moved to *B*, his first moon or satellite has described the curve *a*1, his second the curve *b*1, his third *c*1, and his fourth *d*1. The next day, when Jupiter is at *C*, his first satellite has described the curve *a*2, from its conjunction, his second the curve *b*2, his third the curve *c*2, and his fourth the curve *d*2, and so on. The numeral figures under the capital letters shew Jupiter's place in his path every day for 18 days, accounted from *A* to *T*; and the like figures set to the paths of his satellites, shew where they are at the like times. The first satellite, almost under *C*, is stationary at + as seen from the sun; and retrograde from + to 2: at 2 it appears stationary again, and thence it moves forward until it has past 3, and is twice stationary, and once retrograde, between 3 and 4. The path of this satellite intersects itself every $42\frac{1}{2}$ hours, making such loops as in the diagram at 2 3 5 7 9 10 12 14 16 18, a little after every conjunction. The second satellite *b*, moving slower, barely crosses its path every 3 days 13 hours; as at 4 7 11 14 18, making only five loops and as many conjunctions in the time that the first makes ten. The third satellite *c* moving still slower, and having described the curve *c* 1 2 3 4 5 6 7, comes to an angle at 7 in conjunction with the sun at the end of 7 days 4 hours; and so goes on to describe such another curve 7 8 9 10 11 12 13 14, and is at 14 in its next conjunction. The fourth satellite *d* is always progressive, making neither loops nor angles in the heavens; but comes to its next conjunction at *e* between the numeral figures 16 and 17, or in 16 days 18 hours. In order to have a tolerably good figure of the paths of these satellites, take the following method.

It appears by the scheme, that the three first satellites come almost into the same line or position every seventh day; the first being only a little behind with the second, and the second behind with the third. But the period of the fourth satellite is so incommensurate to the periods of the other three, that it cannot be guessed at by the diagram when it would fall again into a line of conjunction with them, between Jupiter and the sun. And no wonder; for supposing them all to have been once in conjunction, it will require 3,087,043,493,260 years to bring them in conjunction again.

In Plate XLIV. fig. 1. we have the proportions of the orbits of Saturn's five satellites, and of Jupiter's four, to one another, to our moon's orbit, and to the disk of the sun. *S* is the sun; *M m* the moon's orbit, (the earth supposed to be at *E*;), *J* Jupiter; 1 2 3 4 the orbits of his four moons or satellites; *Sat* Saturn; and 1 2 3 4 5 the orbits of his five moons. Hence it appears, that the sun would much more than fill the whole orbit of the moon; for the sun's diameter is 763,000 miles, and the diameter of the moon's orbit only 480,000. In proportion to all these orbits of the satellites, the radius of Saturn's annual orbit would be $21\frac{1}{4}$ yards, of Jupiter's orbit $11\frac{2}{3}$, and of the earth's $2\frac{1}{4}$, taking them in round numbers.

Chap. XIV. *The Phenomena of the Harvest-moon explained by a common Globe: The years in which the Harvest-moons are least and most beneficial from 1751, to 1861. The long Duration of Moon-light at the Poles in Winter.*

It is generally believed that the moon rises about 48 minutes later every day than on the preceding; but this is true only with regard to places on the equator. In places of considerable latitude there is a remarkable difference, especially in the harvest time; with which farmers were better acquainted than astronomers till of late; and gratefully ascribed the early rising of the full moon at that time of the year to the goodness of God, in ordering it so on purpose to give them an immediate supply of moon-light after sun-set for their greater conveniency in reaping the fruits of the earth. And indeed,

In this instance of the harvest-moon, as in many others discoverable by astronomy, the wisdom and beneficence of the Deity is conspicuous, who really ordered the course of the moon so, as to bestow more or less light on all parts of the earth as their several circumstances and seasons render it more or less serviceable. About the equator, where there is no variety of seasons, and the weather changes seldom, and at stated times, moon-light is not necessary for gathering in the produce of the ground;

Plate XLII.

Fig. 1.

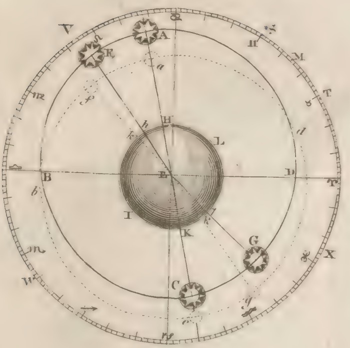


Fig. 2.

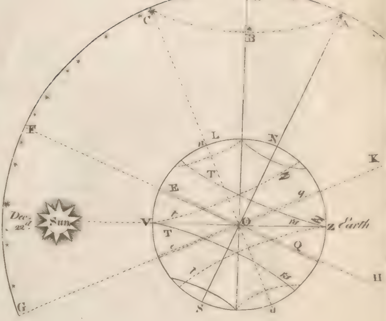


Fig. 3.

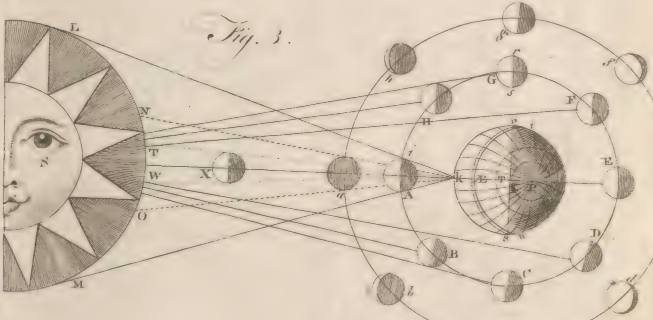


Fig. 4.

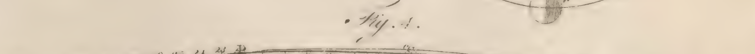
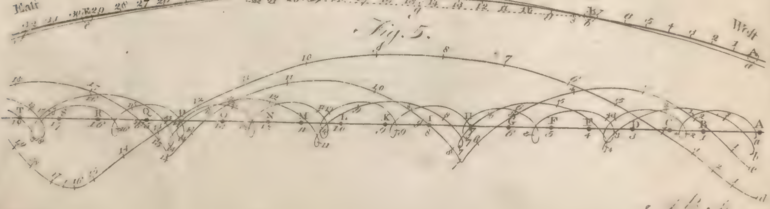


Fig. 5.



ground; and there the moon rises about 48 minutes later every day or night than on the former. At considerable diſtances from the equator, where the weather and ſeaſons are more uncertain, the autumnal full moons riſe very ſoon after ſun-ſet for ſeveral evenings together. At the polar circles, where the mild ſeaſon is of very ſhort duration, the autumnal full moon riſes at ſun-ſet from the firſt to the third quarter. And at the poles, where the ſun is for half a year abſent, the winter full moons ſhine conſtantly without ſetting from the firſt to the third quarter.

It is ſoon ſaid that all theſe phenomena are owing to the different angles made by the horizon and different parts of the moon's orbit; and that the moon can be full but once or twice in a year in thoſe parts of her orbit which riſe with the leaſt angles. But to explain this ſubject intelligibly, we muſt dwell much longer upon it.

The plane of the equinoctial is perpendicular to the earth's axis: and therefore, as the earth turns round its axis, all parts of the equinoctial make equal angles with the horizon both at riſing and ſetting; ſo that equal portions of it always riſe or ſet in equal times. Conſequently, if the moon's motion were equable, and in the equinoctial, at the rate of 12 degrees from the ſun every day, as it is in her orbit, ſhe would riſe and ſet 48 minutes later every day than on the preceding: for 12 degrees of the equinoctial riſe or ſet in 48 minutes of time, in all latitudes.

But the moon's motion is ſo nearly in the ecliptic, that we may conſider her at preſent as moving in it. Now the different parts of the ecliptic, on account of its obliquity to the earth's axis, make very different angles with the horizon as they riſe or ſet. Thoſe parts or ſigns which riſe with the ſmalleſt angles ſet with the greateſt, and *vice verſa*. In equal times, whenever this angle is leaſt, a greater portion of the ecliptic riſes than when the angle is larger; as may be ſeen by elevating the pole of a globe to any conſiderable latitude, and then turning it round its axis in the horizon. Conſequently, when the moon is in thoſe ſigns which riſe or ſet with the ſmalleſt angles, ſhe riſes or ſets with the leaſt difference of time; and with the greateſt difference in thoſe ſigns which riſe or ſet with the greateſt angles.

But, becauſe all who read this treatiſe may not be provided with globes, though in this caſe it is requiſite to know how to uſe them, we ſhall ſubſtitute the figure of a globe; (Plate XLIV. fig. 2.) in which *FUP* is the axis, ♋*TR* the tropic of Cancer, *LTrs* the tropic of Capricorn, ♋*EUrs* the ecliptic touching both the tropics, which are 47 degrees from each other, and *AB* the horizon. The equator, being in the middle between the tropics, is cut by the ecliptic in two oppoſite points, which are the beginnings of ♈ Aries and ♎ Libra. *K* is the hour-circle with its index, *F* the north pole of the globe elevated to a conſiderable latitude, ſuppoſe 40 degrees above the horizon, and *P* the ſouth pole depreſſed as much below it. Becauſe of the oblique poſition of the ſphere in this latitude, the ecliptic has the high elevation *N*♋ above the horizon, making the angle *NU*♋ of $73\frac{1}{2}$ degrees with it when ♋ Cancer is on the meridian, at which time ♎ Libra riſes in the eaſt. But let the globe be turned half round its axis, till *rs* Capricorn comes to the meridian and ♈ Aries riſes in the eaſt, and then the ecliptic will have the low elevation *NL* above the horizon, making only an angle *NUL* of $26\frac{1}{2}$ degrees with it; which is 47 degrees leſs than the former angle, equal to the diſtance between the tropics.

In northern latitudes, the ſmalleſt angle made by the ecliptic and horizon is when Aries riſes, at which time Libra ſets; the greateſt when Libra riſes, at which time Aries ſets. From the riſing of Aries to the riſing of Libra, (which is twelve ſydereal hours), the angle increaſes; and from the riſing of Libra to the riſing of Aries, it decreaſes in the ſame proportion. By this article and the preceding, it appears that the ecliptic riſes faſteſt about Aries, and floweſt about Libra.

On the parallel of London, as much of the ecliptic riſes about Piſces and Aries in two hours as the moon goes through in ſix days; and therefore whilſt the moon is in theſe ſigns, ſhe differs but two hours in riſing for ſix days together; that is, about 20 minutes later every day or night than on the preceding, at a mean rate. But in 14 days afterwards, the moon comes to Virgo and Libra, which are the oppoſite ſigns to Piſces and Aries; and then ſhe differs almoſt four times as much in riſing; namely, one hour and about fifteen minutes later every day or night than the former, whilſt ſhe is in theſe ſigns.

All theſe things will be made plain by putting ſmall patches on the ecliptic of a globe, as far from one another as the moon moves from any point of the celeſtial ecliptic in 24 hours, which at a mean rate is $13\frac{1}{5}$ degrees; and then in turning the globe round, obſerve the riſing and ſetting of the patches in the horizon, as the index points out the different times in the hour-circle. A few of theſe patches are repreſented by dots at 0 1 2 3, *&c.* on the ecliptic, which has the poſition *LUI* when Aries riſes in the eaſt; and by the dots 0 1 2 3, *&c.* when Libra riſes in the eaſt; at which time the ecliptic has the poſition *EUrs*; making an angle of 62 degrees with the horizon in the latter caſe, and an angle of no more than 15 degrees with it in the former; ſuppoſing the globe rectified to the latitude of London.

Having rectified the globe, turn it until the patch at 0, about the beginning of ♓ Piſces in the half *LUI* of the ecliptic, comes to the eaſtern ſide of the horizon; and then keeping the ball ſteady, ſet the hour-index to XII, becauſe *that* hour may perhaps be more eaſily remembered than any other. Then turn the globe round weſtward, and in that time, ſuppoſe the patch 0 to have moved thence to 1, $13\frac{1}{5}$ degrees, whilſt the earth turns once round its axis, and you will ſee that 1 riſes only about 20 minutes later than 0 did on the day before. Turn the globe round again, and in that time ſuppoſe the ſame patch to have moved from 1 to 2; and it will riſe only 20 minutes later by the hour-index than it did at 1 on the day or turn before. At the end of the next turn, ſuppoſe the patch to have gone from 2 to 3 at *U*, and it will riſe 20 minutes later than it did at 2. And ſo on for ſix turns, in which time there will ſcarce be two hours difference: nor would there have been ſo much if the

the 6 degrees of the ſun's motion in that time had been allowed for. At the firſt turn the patch riſes ſouth of the eaſt, at the middle turn due eaſt, and at the laſt turn north of the eaſt. But theſe patches will be 9 hours of ſetting on the weſtern ſide of the horizon, which ſhews that the moon will be ſo much later of ſetting in that week in which ſhe moves through theſe two ſigns. The cauſe of this difference is evident; for Piſces and Aries make only an angle of 15 degrees with the horizon when they riſe; but they make an angle of 62 degrees with it when they ſet. As the ſigns Taurus, Gemini, Cancer, Leo, Virgo, and Libra, riſe ſucceſſively, the angle increaſes gradually which they make with the horizon; and decreaſes in the ſame proportion as they ſet. And for that reaſon, the moon differs gradually more in the time of her riſing every day whilſt ſhe is in theſe ſigns, and leſs in her ſetting: after which, through the other ſix ſigns, *viz.* Scorpio, Sagittary, Capricorn, Aquarius, Piſces, and Aries, the riſing difference becomes leſs every day, until it be at the leaſt of all, namely, in Piſces and Aries.

The moon goes round the ecliptic in 27 days 8 hours; but not from change to change in leſs than 29 days 12 hours: ſo that ſhe is in Piſces and Aries at leaſt once in every lunation, and in ſome lunations twice.

If the earth had no annual motion, the ſun would never appear to ſhift his place in the ecliptic. And then every new moon would fall in the ſame ſign and degree of the ecliptic, and every full moon in the oppoſite; for the moon would go preciſely round the ecliptic from change to change. So that if the moon was once full in Piſces or Aries, ſhe would always be full when ſhe came round to the ſame ſign and degree again. And as the full moon riſes at ſun-ſet (becauſe when any point of the ecliptic ſets, the oppoſite point riſes) ſhe would conſtantly riſe within two hours of ſun-ſet, on the parallel of London, during the week in which ſhe were full. But in the time that the moon goes round the ecliptic from any conjunction or oppoſition, the earth goes almoſt a ſign forward; and therefore the ſun will ſeem to go as far forward in that time, namely, $27\frac{1}{2}$ degrees; ſo that the moon muſt go $27\frac{1}{2}$ degrees more than round, and as much farther as the ſun advances in that interval, which is $2\frac{1}{17}$ degrees, before ſhe can be in conjunction with, or oppoſite to, the ſun again. Hence it is evident, that there can be but one conjunction or oppoſition of the ſun and moon in a year in any particular part of the ecliptic. This may be familiarly exemplified by the hour and minute-hands of a watch, which are never in conjunction or oppoſition in that part of the dial-plate where they were ſo laſt before. And indeed, if we compare the twelve hours on the dial-plate to the twelve ſigns of the ecliptic, the hour-hand to the ſun, and the minute-hand to the moon, we ſhall have a tolerably near reſemblance in miniature to the motions of our great celeſtial luminaries. The only difference is, that whilſt the ſun goes once round the ecliptic, the moon makes $12\frac{1}{3}$ conjunctions with him: but whilſt the hour-hand goes round the dial-plate, the minute-hand makes only 11 conjunctions with it; becauſe the minute-hand moves ſlower in reſpect of the hour-hand than the moon does with regard to the ſun.

As the moon can never be full but when ſhe is oppoſite to the ſun, and the ſun is never in Virgo and Libra but in our autumnal months, it is plain that the moon is never full in the oppoſite ſigns, Piſces and Aries, but in theſe two months. And therefore we can have only two full moons in the year, which riſe ſo near the time of ſun-ſet, for a week together, as above mentioned. The former of theſe is called the *harveſt-moon*, and the latter the *hunter's moon*.

Here it will probably be aſked, Why we never obſerve this remarkable riſing of the moon but in harveſt, ſince ſhe is in Piſces and Aries twelve times in the year beſides; and muſt then riſe with as little difference of time as in harveſt? The anſwer is plain: for in winter theſe ſigns riſe at noon; and being then only a quarter of a circle diſtant from the ſun, the moon in them is in her firſt quarter: But when the ſun is above the horizon, the moon's riſing is neither regarded nor perceived. In ſpring theſe ſigns riſe with the ſun, becauſe he is then in them; and as the moon changeth in them at that time of the year, ſhe is quite inviſible. In ſummer they riſe about midnight, and the ſun being then three ſigns, or a quarter of a circle before them, the moon is in them about her third quarter; when riſing ſo late, and giving but very little light, her riſing paſſes unobſerved. And in autumn, theſe ſigns, being oppoſite to the ſun, riſe when he ſets, with the moon in oppoſition, or at the full, which makes her riſing very conſpicuous.

At the equator, the north and ſouth poles lie in the horizon; and therefore the ecliptic makes the ſame angle ſouthward with the horizon when Aries riſes, as it does northward when Libra riſes. Conſequently, as the moon at all the fore-mentioned patches riſes and ſets nearly at equal angles with the horizon all the year round, and about 48 minutes later every day or night than on the preceding, there can be no particular harveſt-moon at the equator.

The farther that any place is from the equator, if it be not beyond the polar circle, the angle gradually diminiſhes which the ecliptic and horizon make when Piſces and Aries riſe: And therefore, when the moon is in theſe ſigns ſhe riſes with a nearly proportionable difference later every day than on the former; and is for that reaſon the more remarkable about the full, until we come to the polar circles, or 66 degrees from the equator; in which latitude the ecliptic and horizon become coincident every day for a moment, at the ſame ſydereal hour, (or 3 minutes 56 ſeconds ſooner every day than the former), and the very next moment one half of the ecliptic, containing Capricorn, Aquarius, Piſces, Aries, Taurus, and Gemini riſes, and the oppoſite half ſets. Therefore, whilſt the moon is going from the beginning of Capricorn to the beginning of Cancer, which is almoſt 14 days, ſhe riſes at the ſame ſydereal hour; and in autumn, juſt at ſun-ſet, becauſe all that half of the ecliptic, in which the ſun is at that time, ſets at the ſame ſydereal hour, and the oppoſite half riſes; that is, 3 minutes 56 ſeconds, of mean ſolar time, ſooner every day than on the day before. So, whilſt the moon is going from Capricorn to Cancer, ſhe riſes earlier every day than on the preceding, contrary to what ſhe does at all places

places between the polar circles. But, during the above fourteen days, the moon is 24 sydereal hours later in setting; for the six signs, which rise all at once on the eastern side of the horizon, are 24 hours in setting on the western side of it; as any one may see by making chalk-marks at the beginning of Capricorn and of Cancer, and then, having elevated the pole $66\frac{1}{2}$ degrees, turn the globe slowly round its axis, and observe the rising and setting of the ecliptic. As the beginning of Aries is equally distant from the beginning of Cancer and of Capricorn, it is in the middle of that half of the the ecliptic which rises all at once. And when the sun is at the beginning of Libra, he is in the middle of the other half. Therefore, when the sun is in Libra, and the moon in Capricorn, the moon is a quarter of a circle before the sun; opposite to him, and consequently full in Aries, and a quarter of a circle behind him, when in Cancer. But when Libra rises, Aries sets, and all that half of the ecliptic of which Aries is the middle; and therefore, at that time of the year, the moon rises at sun-set from her first to her third quarter.

In northern latitudes, the autumnal full moons are in Pisces and Aries, and the vernal full moons in Virgo and Libra: In southern latitudes just the reverse, because the seasons are contrary. But Virgo and Libra rise at as small angles with the horizon in southern latitudes, as Pisces and Aries do in the northern; and therefore the harvest-moons are just as regular on one side of the equator as on the other.

As these signs, which rise with the least angles, set with the greatest, the vernal full moons differ as much in their times of rising every night, as the autumnal full moons differ in their times of setting; and set with as little difference as the autumnal full moons rise; the one being in all cases the reverse of the other.

Hitherto, for the sake of plainness, we have supposed the moon to move in the ecliptic, from which the sun never deviates. But the orbit in which the moon really moves is different from the ecliptic; one half being elevated $5\frac{1}{3}$ degrees above it, and the other half as much depressed below it. The moon's orbit therefore intersects the ecliptic in two points diametrically opposite to each other; and these intersections are called the *moon's nodes*. So the moon can never be in the ecliptic but when she is in either of her nodes, which is at least twice in every course from change to change, and sometimes thrice. For, as the moon goes almost a whole sign more than round her orbit from change to change, if she passes by either node about the time of change, she will pass by the other in about fourteen days after, and come round to the former node two days again before the next change. That node, from which the moon begins to ascend northward, or above the ecliptic, in northern latitudes, is called the *ascending node*; and the other, the *descending node*; because the moon, when she passes by it, descends below the ecliptic southward.

The moon's oblique motion, with regard to the ecliptic, causes some difference in the times of her rising and setting from what is already mentioned. For whilst she is northward of the ecliptic, she rises sooner and sets later than if she moved in the ecliptic; and when she is southward of the ecliptic, she rises later, and sets sooner. This difference is variable, even in the same signs, because the nodes shift backward about $19\frac{2}{3}$ degrees in the ecliptic every year; and so go round it contrary to the order of signs in 18 years 225 days.

When the ascending node is in Aries, the southern half of the moon's orbit makes an angle of $5\frac{1}{3}$ degrees less with the horizon than the ecliptic does, when Aries rises in northern latitudes: For which reason the moon rises with less difference of time whilst she is in Pisces and Aries, than there would be if she kept in the ecliptic. But in 9 years and 112 days afterward, the descending node comes to Aries; and then the moon's orbit makes an angle $5\frac{1}{3}$ degrees greater with the horizon when Aries rises, that the ecliptic does at that time; which causes the moon to rise with greater difference of time in Pisces and Aries than if she moved in the ecliptic.

To be a little more particular; when the ascending node is in Aries, the angle is only $9\frac{1}{3}$ degrees on the parallel of London when Aries rises. But when the descending node comes to Aries, the angle is $20\frac{1}{3}$ degrees; this occasions as great a difference of the moon's rising in the same signs every 9 years, as there would be on two parallels to $10\frac{2}{3}$ degrees from one another, if the moon's course were in the ecliptic.

As there is a complete revolution of the nodes in $18\frac{2}{3}$ years, there must be a regular period of all the varieties which can happen in the rising and setting of the moon during that time. But this shifting of the nodes never affects the moon's rising so much, even in her quickest descending latitude, as not to allow us still the benefit of her rising nearer the time of sun-set for a few days together about the full in harvest, than when she is full at any other time of the year. The following table shews in what years the harvest-moons are least beneficial as to the times of their rising, and in what years most, from 1751 to 1861. The column of years under the letter L are those in which the harvest-moons are least of all beneficial, because they fall about the descending node; and those under M are the most of all beneficial, because they fall about the ascending node. In all the columns from N to S, the harvest-moons descend gradually in the lunar orbit, and rise to less heights above the horizon. From S to N they ascend in the same proportion, and rise to greater heights above the horizon. In both the columns under S, the harvest-moons are in the lowest part of the moon's orbit, that is, farthest south of the ecliptic; and therefore stay shortest of all above the horizon; in the columns under N, just the reverse. And, in both cases, their rising, though not at the same times, are nearly the same with regard to difference of time, as if the moon's orbit were coincident with the ecliptic.

Years

Years in which the Harveſt-moons are leaſt beneficial.

N				L				S	
1751	1752	1753	1754	1755	1756	1757	1758	1759	
1770	1771	1772	1773	1774	1775	1776	1777	1778	
1788	1789	1790	1791	1792	1793	1794	1795	1796	1797
1807	1808	1809	1810	1811	1812	1813	1814	1815	
1826	1827	1828	1829	1830	1831	1832	1833	1834	
1844	1845	1846	1847	1848	1849	1850	1851	1852	

Years in which they are moſt beneficial.

S				M				N	
1760	1761	1762	1763	1764	1765	1766	1767	1768	1769
1779	1780	1781	1782	1783	1784	1785	1786	1787	
1798	1799	1800	1801	1802	1803	1804	1805	1806	
1816	1817	1818	1819	1820	1821	1822	1823	1824	1825
1835	1836	1837	1838	1839	1840	1841	1842	1843	
1853	1854	1855	1856	1857	1858	1859	1860	1861	

At the polar circles, when the ſun touches the ſummer tropic, he continues 24 hours above the horizon, and 24 hours below it when he touches the winter tropic. For the ſame reaſon, the full moon neither riſes in ſummer, nor ſets in winter, conſidering her as moving in the ecliptic. For the winter full moon being as high in the ecliptic as the ſummer ſun, muſt therefore continue as long above the horizon; and the ſummer full moon being as low in the ecliptic as the winter ſun, can no more riſe than he does. But theſe are only the two full moons which happen about the tropics, for all the others riſe and ſet. In ſummer, the full moons are low, and their ſtay is ſhort above the horizon, when the nights are ſhort, and we have leaſt occaſion for moon-light: In winter, they go high, and ſtay long above the horizon, when the nights are long, and we want the greateſt quantity of moon-light.

At the poles, one half of the ecliptic never ſets, and the other half never riſes; and therefore, as the ſun is always half a year in deſcribing one half of the ecliptic, and as long in going through the other half, it is natural to imagine that the ſun continues half a year together above the horizon of each pole in its turn, and as long below it, riſing to one pole when he ſets to the other. This would be exactly the caſe if there were no refraction; but by the atmoſphere's refracting the ſun's rays, he becomes viſible ſome days ſooner, and continues ſome days longer in ſight than he would otherwiſe do: ſo that he appears above the horizon of either pole before he has got below the horizon of the other. And as he never goes more than $23\frac{1}{2}$ degrees below the horizon of the poles, they have very little dark night; it being twilight there as well as at all other places till the ſun be 18 degrees below the horizon. The full moon being always oppoſite to the ſun, can never be ſeen while the ſun is above the horizon, except when the moon falls in the northern half of her orbit; for whenever any point of the ecliptic riſes, the oppoſite point ſets. Therefore, as the ſun is above the horizon of the north pole from the 20th of March till the 23d of September, it is plain, that the moon, when full, being oppoſite to the ſun, muſt be below the horizon during that half of the year. But when the ſun is in the ſouthern half of the ecliptic, he never riſes to the north pole, during which half of the year, every full moon happens in ſome part of the northern half of the ecliptic, which never ſets. Conſequently, as the polar inhabitants never ſee the full moon in ſummer, they have her always in the winter, before, at, and after the full, ſhining for 14 of our days and nights. And when the ſun is at his greateſt depreſſion below the horizon, being then in Capricorn, the moon is at her firſt quarter in Aries, full in Cancer, and at her third quarter in Libra. And as the beginning of Aries is the riſing point of the ecliptic, Cancer the higheſt, and Libra the ſetting point, the moon riſes at her firſt quarter in Aries, is moſt elevated above the horizon, and full in Cancer, and ſets at the beginning of Libra in her third quarter, having continued viſible for 14 diurnal rotations of the earth. Thus the poles are ſupplied one half of the winter time with conſtant moon-light in the ſun's abſence; and only loſe ſight of the moon from her third to her firſt quarter, while ſhe gives but very little light, and could be but of little, and ſometimes of no ſervice to them. A bare view of the figure (Plate XLIV. fig. 3.) will make this plain; in which let S be the ſun, e the earth in ſummer when its north pole n inclines toward the ſun, and E the earth in winter, when its north north pole declines from him. SEN and NWS is the horizon of the north pole, which is coincident with the equator; and, in both theſe poſitions of the earth, ♈♋♎*rs* is the moon's orbit, in which ſhe goes round the earth according to the order of the letters *abcd*, *ABCD*. When the moon is at a, ſhe is in her third quarter to the earth at e, and juſt riſing to the north pole n; at b ſhe changes, and is at the greateſt height above the horizon, as the ſun likewiſe is; at c ſhe is in her firſt quarter, ſetting below the horizon; and is loweſt of all under it at d, when oppoſite to the ſun, and her enlightened ſide toward the earth. But then ſhe is full in view to the ſouth pole p, which is as much turned from the ſun as the north pole inclines towards him. Thus, in our ſummer, the moon is above the horizon of the north pole

Plate XLIV.

Fig. 1.

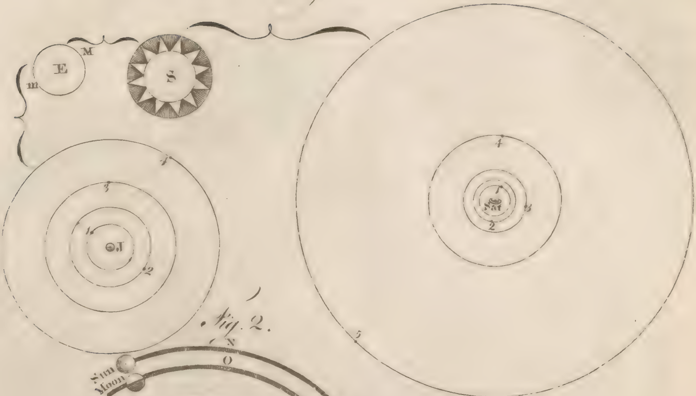


Fig. 2.

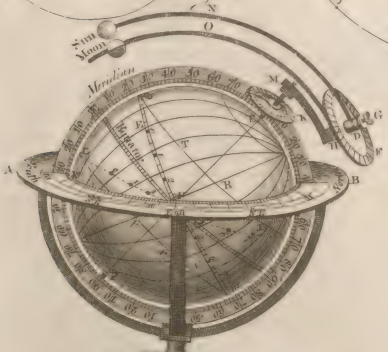
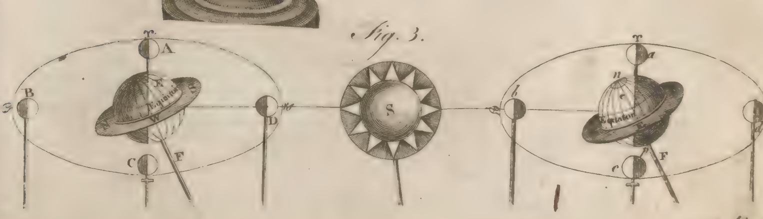


Fig. 4.

Fig. 3.



pole whilst she describes the northern half of the ecliptic ♈♋♎, or from her third quarter to her first; and below the horizon during her progress through the southern half ♎♑♈; highest at the change, most depressed at the full. But in winter, when the earth is at E, and its north pole declines from the sun, the new moon at D is at her greatest depression below the horizon NWS, and the full moon at B at her greatest height above it, rising at her first quarter A, and keeping above the horizon till she comes to her third quarter C. At a mean state she is $23\frac{1}{2}$ degrees above the horizon at B and b, and as much below it at D and d, equal to the inclination of the earth's axis F. S♋ and Srs are, as it were, a ray of light proceeding from the sun to the earth; and shews, that when the earth is at e, the sun is above the horizon, vertical to the tropic of Cancer; and when the earth is at E, he is below the horizon, vertical to the tropic of Capricorn.

Chap. XV. *Of the Ebbing and Flowing of the Sea.*

The cause of the tides was discovered by Kepler, who, in his *Introduction to the Physics of the Heavens*, thus explains it: "The orb of the attracting power, "which is in the moon, is extended as far as the earth, "and draws the waters under the torrid zone, acting "upon places where it is vertical, insensibly on confined "seas and bays, but sensibly on the ocean, whose beds "are large, and the waters have the liberty of reciprocation; that is, of rising and falling." And in the 70th page of his *Lunar Astronomy*:—"But the cause "of the tides of the sea appears to be the bodies of the "sun and moon drawing the waters of the sea." This hint being given, Sir Isaac Newton improved it, and wrote so amply on the subject, as to make the theory of the tides in a manner quite his own; by discovering the cause of their rising on the side of the earth opposite to the moon. For Kepler believed, that the presence of the moon occasioned an impulse which caused another in her absence.

The power of gravity diminishes as the square of the distance increases; and therefore the waters (Plate XLIV. fig. 4.) at Z on the side of the earth $ABCDEFGH$ next the moon M are more attracted than the central parts of the earth O by the moon, and the central parts are more attracted by her than the waters on the opposite side of the earth at n; and therefore the distance between the earth's centre and the waters on its surface under and opposite to the moon will be increased. For, let there be three bodies at H, O, and D, if they are all equally attracted by the body M, they will all move equally fast toward it, their mutual distances from each other continuing the same. If the attraction of M is unequal, then that body which is most strongly attracted will move fastest, and this will increase its distance from the other body. Therefore, by the law of gravitation, M will attract H more strongly than it does O, by which the distance between H and O will be increased, and a spectator on O will perceive H rising higher toward Z. In like manner, O being more strongly attracted than D, it will move farther towards M than D does; consequently the distance between O and D will be increased, and a spectator on O, not perceiving his own motion, will see D receding farther from him towards n; all effects and appearances being the same, whether D recedes from O, or O from D.

Suppose now there is a number of bodies, as $ABCDEFGH$, placed round O, so as to form a flexible or fluid ring; then, as the whole is attracted towards M, the parts at H and D will have their distance from O increased; whilst the parts at B and F, being nearly at the same distance from M as O is, these parts will not recede from one another, but rather, by the oblique attraction of M, they will approach nearer to O. Hence the fluid ring will form itself into an ellipse $ZIBLnKFNZ$, whose longer axis nOZ produced will pass through M, and its shorter axis BOF will terminate in B and F. Let the ring be filled with bodies, so as to form a fluid sphere round G; then, as the whole moves toward M, the fluid sphere being lengthened at Z and n, will assume an oblong or oval form. If M is the moon, O the earth's centre, $ABCDEFGH$ the sea covering the earth's surface, it is evident, by the above reasoning, that whilst the earth by its gravity falls toward the moon, the water directly below her at B will swell and rise gradually towards her; also the water at D will recede from the centre, (strictly speaking the centre recedes from D), and rise on the opposite side of the earth, whilst the water at B and F is depressed, and falls below the former level. Hence, as the earth turns round its axis from the moon to the moon again in $24\frac{3}{4}$ hours, there will be two tides of flood and two of ebb in that time, as we find by experience.

As this explanation of the ebbing and flowing of the sea is deduced from the earth's constantly falling toward the moon by the power of gravity, some may find a difficulty in conceiving how this is possible, when the moon is full, or in opposition to the sun, since the earth revolves about the sun, and must continually fall towards it, and therefore cannot fall contrary ways at the same time; or if the earth is constantly falling towards the moon, they must come together at last. To remove this difficulty, let it be considered, that it is not the centre of the earth that describes the annual orbit round the sun, but the common centre of gravity of the earth and moon together; and that whilst the earth is moving round the sun, it also describes a circle round that centre of gravity, going as many times round it in one revolution about the sun as there are lunations or courses of the moon round the earth in a year; and therefore the earth is constantly falling towards the moon from a tangent to the circle it describes round the said common centre of gravity. In Plate XLV, fig. 1. let M be the moon, TW part of the moon's orbit, and C the centre of gravity of the earth and moon; whilst the moon goes round her orbit, the centre of the earth describes the circle ged round C, to which circle gak is a tangent; and therefore when the moon has gone from M to a little past W, the earth has moved from g to e; and in that time

time has fallen towards the moon, from the tangent at *a* to *e*, and so round the whole circle.

The sun's influence in raising the tides is but small in comparison of the moon's: For though the earth's diameter bears a considerable proportion to its distance from the moon, it is next to nothing when compared with the distance of the sun. And therefore, the difference of the sun's attraction on the sides of the earth under and opposite to him, is much less than the difference of the moon's attraction on the sides of the earth under and opposite to her; and therefore the moon must raise the tides much higher than they can be raised by the sun.

On this theory, so far as we have explained it, the tides ought to be highest directly under and opposite to the moon; that is, when the moon is due north and south. But we find, that in open seas, where the water flows freely, the moon *M* (Plate XLIV. fig. 4.) is generally past the north and south meridian, as at *p*, when it is high water at *Z* and at n. The reason is obvious; for though the moon's attraction was to cease altogether when she was past the meridian, yet the motion of ascent communicated to the water before that time would make it continue to rise for some time after; much more must it do so when the attraction is only diminished: as a little impulse given to a moving ball will cause it still to move farther than otherwise it could have done. And as experience shews, that the day is hotter about three in the afternoon, than when the sun is on the meridian, because of the increment made to the heat already imparted.

The tides answer not always to the same distance of the moon from the meridian at the same places, but are variously affected by the action of the sun, which brings them on sooner when the moon is in her first and third quarters, and keeps them back later when she is in her second and fourth; because in the former case the tide raised by the sun alone would be earlier than the tide raised by the moon, and in the latter case later.

The moon goes round the earth in an elliptic orbit, and therefore she approaches nearer to the earth than her mean distance, and recedes farther from it, in every lunar month. When she is nearest, she attracts strongest, and so raises the tides most; the contrary happens when she is farthest, because of her weaker attraction. When both luminaries are in the equator, and the moon in *Perigeo*, or at her least distance from the earth, she raises the tides highest of all, especially at her conjunction and opposition; both because the equatoreal parts have the greatest centrifugal force from their describing the largest circle, and from the concurring actions of the sun and moon. At the change, the attractive forces of the sun and moon being united, they diminish the gravity of the waters under the moon, and their gravity on the opposite side is diminished by means of a greater centrifugal force. At the full, whilst the moon raises the tide under and opposite to her, the sun acting in the same line, raises the tide under and opposite to him; whence their conjoint effect is the same as at the change; and in both cases, occasion what we call the *spring-tides*. But at the quarters, the sun's action on the waters at *O* and *H* (Plate XLV. fig. 2.) diminishes the effect of the moon's action on the waters at *Z* and *N*; so that they rise a little under and opposite to the sun at *O* and *H*, and fall as much under and opposite to the moon at *Z* and *N*, making what we call the *neap-tides*, because the sun and moon then act cross-wise to each other. But, strictly speaking, these tides happen not till some time after; because in this, as in other cases, the actions do not produce the greatest effect when they are at the strongest, but some time afterward.

The sun being nearer the earth in winter than in summer, is of course nearer to it in February and October than in March and September; and therefore the greatest tides happen not till some time after the autumnal equinox, and return a little before the vernal.

The sea being thus put in motion, would continue to ebb and flow for several times, even though the sun and moon were annihilated, or their influence should cease: as if a bason of water were agitated, the water would continue to move for some time after the bason was left to stand still. Or like a pendulum, which having been put in motion by the hand, continues to make several vibrations without any new impulse.

When the moon is in the equator, the tides are equally high in both parts of the lunar day, or time of the moon's revolving from the meridian to the meridian again, which is 24 hours 48 minutes. But as the moon declines from the equator towards either pole, the tides are alternately higher and lower at places having north or south latitude. For one of the highest elevations, which is that under the moon, follows her towards the pole to which she is nearest, and the other declines towards the opposite pole; each elevation describing parallels as far distant from the equator, on opposite sides, as the moon declines from it to either side; and consequently, the parallels described by these elevations of the water are twice as many degrees from one another, as the moon is from the equator; increasing their distance as the moon increases her declination, till it be at the greatest, when the said parallels are, at a mean state, 47 degrees from one another: and on that day, the tides are most unequal in their heights. As the moon returns toward the equator, the parallels described by the opposite elevations approach towards each other, until the moon comes to the equator, and then they coincide. As the moon declines toward the opposite pole, at equal distances, each elevation describes the same parallel in the other part of the lunar day, which its opposite elevation described before. Whilst the moon has north declination, the greatest tides in the northern hemisphere are when she is above the horizon; and the reverse whilst her declination is south. In Plate XLV. let *NESQ* be the earth, *NCS* its axis, *EQ* the equator, *T♋* the tropic of Cancer, *trs* the tropic of Capricorn, *ab* the arctic circle, *cd* the antarctic, *N* the north pole, *S* the south pole, *M* the moon, *F* and *G* the two eminences of water, whose lowest parts are at *a* and *d*, (fig. 3.), at *N* and *S*, (fig. 4.), and at *b* and *c*, (fig. 5.), always 90 degrees from the highest. Now when the moon is in her greatest north declination at *M*, the highest elevation *G* under her, is on the tropic of Cancer, *T♋*, and the opposite elevation *F* on the tropic of Capricorn *trs*; and these two elevations describe the tropics

pics by the earth's diurnal rotation. All places in the northern hemifphere *ENQ* have the higheft tides when they come into the pofition *b♋Q*, under the moon; and the loweft tides when the earth's diurnal rotation carries them into the pofition *aTE*, on the fide oppofite to the moon; the reverfe happens at the fame time in the fouthern hemifphere *ESQ*, as is evident to fight. The axis of the tides *aCd* has now its poles *a* and *d* (being always 90 degrees from the higheft elevations) in the arctic and antarctic circles; and therefore it is plain, that at thefe circles there is but one tide of flood, and one of ebb, in the lunar day. For, when the point *a* revolves half round to *b*, in 12 lunar hours, it has a tide of flood; but when it comes to the fame point *a* again in 12 hours more, it has the loweft ebb. In feven days afterward, the moon *M* comes to the equinoctial circle, and is over the equator *EQ*, when both elevations defcribe the equator; and in both hemifpheres, at equal diftances from the equator, the tides are equally high in both parts of the lunar day. The whole phenomena being reverfed, when the moon has fouth declination, to what they were when her declination was north, require no farther defcription.

In Plate XLV. fig. 3. 4. 5. the earth is orthographically projected on the plane of the meridian; but in order to defcribe a particular phenomenon, we now project it on the plane of the ecliptic. In the fame Plate fig. 2. let *HZON* be the earth and fea, *FED* the equator, *T* the tropic of Cancer, *C* the arctic circle, *P* the north pole, and the curves 1 2 3, *&c.* 24 meridians, or hour-circles, interfecting each other in the poles; *AGM* is the moon's orbit, *S* the Sun, *M* the moon, *Z* the water elevated under the moon, and *N* the oppofite equal elevation. As the loweft parts of the water are always 90 degrees from the higheft, when the moon is in either of the tropics, (as at *M*), the elevation *Z* is on the tropic of Capricorn, and the oppofite elevation *N* on the tropic of Cancer, the low-water circle *HCO* touches the polar circles at *C*; and the high-water circle *ETP6* goes over the poles at *P*, and divides every parallel of latitude into two equal fegments. In this cafe the tides upon every parallel are alternately higher and lower; but they return in equal times: The point *T*, for example, on the tropic of Cancer, (where the depth of the tide is reprefented by the breadth of the dark fhade), has a fhallower tide of flood at *T* than when it revolves half round from thence to 6, according to the order of the numeral figures; but it revolves as foon from 6 to *T* as it did from *T* to 6. When the moon is in the equinoctial, the elevations *Z* and *N* are transferred to the equator at *O* and *H*, and the high and low-water circles are got into each other's former places; in which cafe the tides return in unequal times, but are equally high in both parts of the lunar day: for a place at 1 (under *D*) revolving as formerly, goes fooner from 1 to 11, (under *F*), than from 11 to 1, becaufe the parallel it defcribes is cut into unequal fegments by the high-water circle *HCO*: but the points 1 and 11 being equidiftant from the pole of the tides at *C*, which is directly under the pole of the moon's orbit *MGA*, the elevations are equally high in both parts of the day.

And thus it appears, that as the tides are governed by the moon, they muft turn on the axis of the moon's orbit, which is inclined $23\frac{1}{2}$ degrees to the earth's axis at a mean ftate: and therefore the poles of the tides muft be fo many degrees from the poles of the earth, or in oppofite points of the polar circles, going round thefe circles in every lunar day. It is true, that, according to Plate XLV. fig. 4. when the moon is vertical to the equator *ECQ*, the poles of the tides feem to fall in with the poles of the world *N* and *S*: but when we confider that *FHG* is under the moon's orbit, it will appear, that when the moon is over *H*, in the tropic of Capricorn, the north pole of the tides (which can be no more than 90 degrees from under the moon) muft be at *c* in the arctic circle, not at *N*, the north pole of the earth; and as the moon afcends from *H* to *G* in her orbit, the north pole of the tides muft fhift from *c* to *a* in the arctic circle, and the fouth pole as much in the antarctic.

It is not to be doubted, but that the earth's quick rotation brings the poles of the tides nearer to the poles of the world, than they would be if the earth were at reft, and the moon revolved about it only once a month; for otherwife the tides would be more unequal in their heights, and times of their returns, than we find they are. But how near the earth's rotation may bring the poles of its axis and thofe of the tides together, or how far the preceding tides may affect thofe which follow, fo as to make them keep up nearly to the fame heights, and times of ebbing and flowing, is a problem more fit to be folved by obfervation than by theory.

Thofe who have opportunity to make obfervations, and chufe to fatisfy themfelves whether the tides are really affected in the above manner by the different pofitions of the moon, efpecially as to the unequal times of their returns, may take this general rule for knowing when they ought to be fo affected. When the earth's axis inclines to the moon, the northern tides, if not retarded in their paffage through fhoals and channels, nor affected by the winds, ought to be greateft when the moon is above the horizon, leaft when fhe is below it, and quite the reverfe when the earth's axis declines from her; but, in both cafes, at equal intervals of time. When the earth's axis inclines fidewife to the moon, both tides are equally high, but they happen at unequal intervals of time. In every lunation the earth's axis inclines once to the moon, once from her, and twice fidewife to her, as it does to the fun every year; becaufe the moon goes round the ecliptic every month, and the fun but once in a year. In fummer, the earth's axis inclines towards the moon when new; and therefore the day-tides in the north ought to be higheft, and night-tides loweft about the change; at the full the reverfe. At the quarters they ought to be equally high, but unequal in their returns; becaufe the earth's axis then inclines fidewife to the moon. In winter the phenomena are the fame at full-moon as in fummer at new. In autumn the earth's axis inclines fidewife to the moon when new and full; therefore the tides ought to be equally high, and unequal in their returns at thefe times. At the firft quarter the tides of flood fhould be leaft when the moon is above the horizon, greateft when fhe is below it; and the reverfe

at

at her third quarter. In ſpring, the phenomema of the firſt quarter anſwer to thoſe of the third quarter in autumn; and *vice verſa.* The nearer any time is to either of theſe ſeaſons, the more the tides partake of the phenomena of theſe ſeaſons; and in the middle between any two of them the tides are at a mean ſtate between thoſe of both.

In open ſeas, the tides riſe but to very ſmall heights in proportion to what they do in wide-mouthed rivers, opening in the direction of the ſtream of tide. For, in channels growing narrower gradually, the water is accumulated by the oppoſition of the contracting bank; like a gentle wind, little felt on an open plain, but ſtrong and briſk in a ſtreet; eſpecially if the wider end of the ſtreet be next the plain, and in the way of the wind.

The tides are ſo retarded in their paſſage through different ſhoals and channels, and otherwiſe ſo variouſly affected by ſtriking againſt capes and headlands, that to different places they happen at all diſtances of the moon from the meridian; conſequently at all hours of the lunar day. The tide propagated by the moon in the German ocean, when ſhe is three hours paſt the meridian, takes 12 hours to come from thence to London-Bridge; where it arrives by the time that a new tide is raiſed in the ocean. And therefore when the moon has north declination, and we ſhould expect the tide at London to be greateſt when the moon is above the horizon, we find it is leaſt; and the contrary when ſhe has ſouth declination. At ſeveral places it is high water three hours before the moon comes to the meridian; but that tide which the moon puſhes as it were before her, is only the tide oppoſite to that which was raiſed by her when ſhe was nine hours paſt the oppoſite meridian.

There are no tides in lakes, becauſe they are generally ſo ſmall, that when the moon is vertical ſhe attracts every part of them alike, and therefore, by rendering all the water equally light, no part of it can be raiſed higher than another. The Mediterranean and Baltic ſeas ſuffer very ſmall elevations, becauſe the inlets by which they communicate with the ocean are ſo narrow, that they cannot, in ſo ſhort a time, receive or diſcharge enough to raiſe or ſink their ſurfaces ſenſibly.

Air being lighter than water, and the ſurface of the atmoſphere being nearer to the moon than the ſurface of the ſea, it cannot be doubted that the moon raiſes much higher tides in the air than in the ſea. And therefore many have wondered why the mercury does not ſink in the barometer when the moon's action on the particles of air makes them lighter as ſhe paſſes over the meridian. But we muſt conſider, that as theſe particles are rendered lighter, a greater number of them is accumulated, until the deficiency of gravity be made up by the height of the column; and then there is an *equilibrium*, and conſequently an equal preſſure upon the mercury as before; ſo that it cannot be affected by the aerial tides.

Chap. XVI. *Of Eclipſes: Their Number and Periods. A large Catalogue of ancient and modern Eclipſes.*

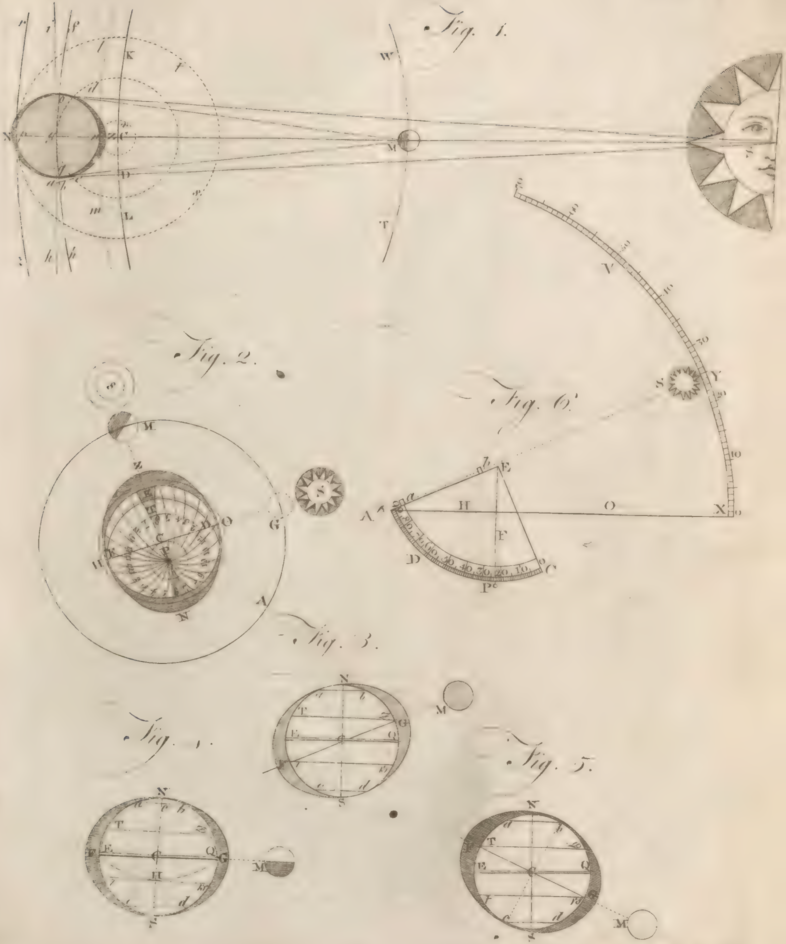
Every planet and ſatellite is illuminated by the ſun; and caſts a ſhadow towards that point of the heavens which is oppoſite to the ſun. This ſhadow is nothing but a privation of light in the ſpace hid from the ſun by the opaque body that intercepts his rays.

When the ſun's light is ſo intercepted by the moon, that to any place of the earth the ſun appears partly or wholly covered, he is ſaid to *undergo an eclipſe*; though, properly ſpeaking, it is only an eclipſe of that part of the earth where the moon's ſhadow or penumbra falls. When the earth comes between the ſun and moon, the moon falls into the earth's ſhadow; and, having no light of her own, ſhe ſuffers a real eclipſe from the interception of the ſun's rays. When the ſun is eclipſed to us, the moon's inhabitants, on the ſide next the earth, ſee her ſhadow like a dark ſpot travelling over the earth, about twice as faſt as its equatoreal parts move, and the ſame way as they move. When the moon is in an eclipſe, the ſun appears eclipſed to her, total to all thoſe parts on which the earth's ſhadow falls, and of as long continuance as they are in the ſhadow.

That the earth is ſpherical (for the hills take off no more from the roundneſs of the earth, than grains of duſt do from the roundneſs of a common globe) is evident from the figure of its ſhadow on the moon; which is always bounded by a circular line, although the earth is inceſſantly turning its different ſides to the moon, and very ſeldom ſhews the ſame ſide to her in different eclipſes, becauſe they ſeldom happen at the ſame hours. Were the earth ſhaped like a round flat plate, its ſhadow would only be circular when either of its ſides directly faced the moon; and more or leſs elliptical as the earth happened to be turned more or leſs obliquely towards the moon when ſhe is eclipſed. The moon's different phaſes prove her to be round; for, as ſhe keeps ſtill the ſame ſide towards the earth, if that ſide were flat, as it appears to be, ſhe would never be viſible from the third quarter to the firſt; and from the firſt quarter to the third, ſhe would appear as round as when we ſay *ſhe is full*; becauſe, at the end of her firſt quarter, the ſun's light would come as ſuddenly on all her ſide next the earth, as it does on a flat wall, and go off as abruptly at the end of her third quarter.

If the earth and ſun were equally large, the earth's ſhadow would be infinitely extended, and all of the ſame bulk; and the planet Mars, in either of its nodes and oppoſite to the ſun, would be eclipſed in the earth's ſhadow. Were the earth larger than the ſun, its ſhadow would increaſe in bulk the farther it extended, and would eclipſe the great planets Jupiter and Saturn, with all their moons, when they were oppoſite to the ſun. But as Mars, in oppoſition, never falls into the earth's ſhadow, although he is not then above 42 millions of miles from the earth, it is plain that the earth is much leſs than the ſun; for otherwiſe its ſhadow could not end in a point at ſo ſmall a diſtance. If the ſun and moon were equally large, the moon's ſhadow would go on to the earth with an equal breadth, and cover a portion of the earth's ſurface more than 2000 miles broad, even if it fell directly againſt the earth's centre, as ſeen from the moon; and much more if it fell obliquely on the earth: But the moon's ſhadow is ſeldom 150 miles broad at the earth, unleſs when it falls very

Plate. XLV.



A. Bell, Sculpt.

very obliquely on the earth, in total eclipſes of the ſun. In annular eclipſes, the moon's real ſhadow ends in a point at ſome diſtance from the earth. The moon's ſmall diſtance from the earth, and the ſhortneſs of her ſhadow, prove her to be leſs than the ſun. And, as the earth's ſhadow is large enough to cover the moon, if her diameter were three times as large as it is (which is evident from her long continuance in the ſhadow when ſhe goes through its centre) it is plain, that the earth is much bigger than the moon.

Though all opaque bodies, on which the ſun ſhines, have their ſhadows, yet ſuch is the bulk of the ſun, and the diſtances of the planets, that the primary planets can never eclipſe one another. A primary can eclipſe only its ſecondary, or be eclipſed by it; and never but when in oppoſition or conjunction with the ſun. The primary planets are very ſeldom in theſe poſitions, but the ſun and moon are ſo every month: Whence one may imagine, that theſe two luminaries ſhould be eclipſed every month. But there are few eclipſes in reſpect of the number of new and full moons; the reaſon of which we ſhall now explain.

If the moon's orbit were coincident with the plane of the ecliptic, in which the earth always moves and the ſun appears to move, the moon's ſhadow would fall upon the earth at every change, and eclipſe the ſun to ſome parts of the earth. In like manner, the moon would go through the middle of the earth's ſhadow, and be eclipſed at every full; but with this difference, that ſhe would be totally darkened for above an hour and an half; whereas the ſun never was above four minutes totally eclipſed by the interpoſition of the moon. But one half of the moon's orbit is elevated $5\frac{1}{3}$ degrees above the ecliptic, and the other half as much depreſſed below it; conſequently, the moon's orbit interſects the ecliptic in two oppoſite points called the *moon's nodes*, as has been already taken notice of. When theſe points are in a right line with the centre of the ſun at new or full moon, the ſun, moon, and earth, are all in a right line; and if the moon be then new, her ſhadow falls upon the earth; if full, the earth's ſhadow falls upon her. When the ſun and moon are more than 17 degrees from either of the nodes at the time of conjunction, the moon is then generally too high or too low in her orbit to caſt any part of her ſhadow upon the earth; when the ſun is more than 12 deg. from either of the nodes at the time of full moon, the moon is generally too high or too low in her orbit to go thro' any part of the earth's ſhadow: And in both theſe caſes there will be no eclipſe. But when the moon is leſs than 17 degrees from either node at the time of conjunction, her ſhadow or penumbra falls more or leſs upon the earth, as ſhe is more or leſs within this limit. And when ſhe is leſs than 12 degrees from either node at the time of oppoſition, ſhe goes through a greater or leſs portion of the earth's ſhadow, as ſhe is more or leſs within this limit. Her orbit contains 360 degrees; of which 17, the limit of ſolar eclipſes on either ſide of the nodes, and 12, the limit of lunar eclipſes, are but ſmall portions: And as the ſun commonly paſſes by the nodes but twice in a year, it is no wonder that we have ſo many new and full moons without eclipſes.

To illuſtrate this, (Plate XLVI. fig. 1.) let *ABCD* be the ecliptic, *RSTU* a circle lying in the ſame plane with the ecliptic, and *VWXY* the moon's orbit, all thrown into an oblique view, which gives them an elliptical ſhape to the eye. One half of the moon's orbit, as *VWX*, is always below the ecliptic, and the other half *XYV* above it. The points *V* and *X*, where the moon's orbit interſects the circle *RSTU*, which lies even with the ecliptic, are the moon's nodes; and a right line, as *XEV*, drawn from one to the other, through the earth's centre, is the line of the nodes, which is carried almoſt parallel to itſelf round the ſun in a year.

If the moon moved round the earth in the orbit *RSTU*, which is coincident with the plane of the ecliptic, her ſhadow would fall upon the earth every time ſhe is in conjunction with the ſun, and at every oppoſition ſhe would go through the earth's ſhadow. Were this the caſe, the ſun would be eclipſed at every change, and the moon at every full, as already mentioned.

But although the moon's ſhadow *N* muſt fall upon the earth at *a*, when the earth is at *E*, and the moon in conjunction with the ſun at *i*, becauſe ſhe is then very near one of her nodes; and at her oppoſition *n* ſhe muſt go through the earth's ſhadow *I*, becauſe ſhe is then near the other node; yet, in the time that ſhe goes round the earth to her next change, according to the order of the letters *XYVW*, the earth advances from *E* to *e*, according to the order of the letters *EFGH*, and the line of the nodes *VEX* being carried nearly parallel to itſelf, brings the point *f* of the moon's orbit in conjunction with the ſun at that next change; and then the moon being at *f*, is too high above the ecliptic to caſt her ſhadow on the earth: And as the earth is ſtill moving forward, the moon at her next oppoſition will be at *g*, too far below the ecliptic to go through any part of the earth's ſhadow; for by that time the point *g* will be at a conſiderable diſtance from the earth as ſeen from the ſun.

When the earth comes to *F*, the moon in conjunction with the ſun *Z* is not at *k* in a plane coincident with the ecliptic, but above it at *Y* in the higheſt part of her orbit: and then the point *b* of her ſhadow *O* goes far above the earth (as in fig. 2. which is an edge view of fig. 1.) The moon, at her next oppoſition, is not at *o* (fig. 1.) but at *W*, where the earth's ſhadow goes far above her (as in fig. 2.) In both theſe caſes the line of the nodes *VFX* (fig. 1.) is about 90 degrees from the ſun, and both luminaries are as far as poſſible from the limits of the eclipſes.

When the earth has gone half round the ecliptic from *E* to *G*, the line of the nodes *VGX* is nearly, if not exactly, directed towards the ſun at *Z*; and then the new-moon *l* caſts her ſhadow *P* on the earth *G*; and the full moon *p* goes through the earth's ſhadow *L*; which brings on eclipſes again, as when the earth was at *E*.

When the earth comes to *H*, the new moon falls not at *m* in a plane coincident with the ecliptic *CD*, but at *W* in her orbit below it; and then her ſhadow *Q* (ſee fig. 2.) goes far below the earth. At the next full ſhe is not at *q* (fig. 1.) but at *Y* in her orbit $5\frac{1}{3}$ degrees above *q*, and at her greateſt height above the ecliptic *CD*; being then as far as poſſible, at any oppoſition, from the earth's ſhadow *M*, as in fig. 2.

So, when the earth is at *E* and *G*, the moon is about her

her nodes at new and full; and in her greatest *north* and *south declination* (or latitude, as it is generally called) from the ecliptic at her quarters: But when the earth is at *F* or *H*, the moon is in her greatest *north* and *south declination* from the ecliptic at new and full, and in the *nodes* about her quarters.

The point *X* where the moon's orbit crosses the ecliptic, is called *the ascending node*, because the moon ascends from it above the ecliptic: And the opposite point of intersection *V* is called *the descending node*, because the moon descends from it below the ecliptic. When the moon is at *Y* in the highest point of her orbit, she is in her greatest *north latitude*; and when she is at *W* in the lowest point of her orbit, she is in her greatest *south latitude*.

If the line of the nodes, like the earth's axis, was carried parallel to itself round the sun, there would be just half a year between the conjunctions of the sun and nodes. But the nodes shift backward, or contrary to the earth's annual motion, 19⅓ deg. every year; and therefore the same node comes round to the sun 19 days sooner every year than on the year before. Consequently, from the time that the ascending node *X* (when the earth is at *E*) passes by the sun as seen from the earth, it is only 173 days (not half a year) till the descending node *V* passes by him. Therefore, in whatever time of the year we have eclipses of the luminaries about either node, we may be sure that in 173 days afterward we shall have eclipses about the other node. And when at any time of the year the line of the nodes is in the situation *VGX*, at the same time next year it will be in the situation *rGs*; the ascending node having gone backward, that is, contrary to the order of signs, from *X* to *s*, and the descending node from *V* to *r*; each 19⅓ deg. At this rate the nodes shift through all the signs and degrees of the ecliptic in 18 years and 225 days; in which time there would always be a regular period of eclipses, if any complete number of lunations were finished without a fraction. But this never happens; for if both the sun and moon should start from a line of conjunction with either of the nodes in any point of the ecliptic, the sun would perform 18 annual revolutions and 222 degrees over and above, and the moon 230 lunations and 85 degrees of the 231st, by the time the node came round to the same point of the ecliptic again: So that the sun would then be 138 degrees from the node, and the moon 85 degrees from the sun.

But, in 223 mean lunations, after the sun, moon, and nodes, have been once in a line of conjunction, they return so nearly to the same state again, as that the same node, which was in conjunction with the sun and moon at the beginning of the first of these lunations, will be within 28′ 12″ of a degree of a line of conjunction with the sun and moon again, when the last of these lunations is completed. And therefore, in that time there will be a regular period of eclipses, or return of the same eclipse, for many ages.—In this period, (which was first discovered by the Chaldeans), there are 18 Julian years 11 days 7 hours 43 minutes 20 seconds, when the last day of February in leap-years is four times included: But when it is five times included, the period consists of only 18 years 10 days 7 hours 43 minutes 20 seconds. Consequently, if to the mean time of any eclipse, either of the sun or moon, you add 18 Julian years 11 days 7 hours 43 minutes 20 seconds, when the last day of February in leap-years comes in four times, or a day less when it comes in five times, you will have the mean time of the return of the same eclipse.

But the falling back of the line, or conjunctions, or oppositions of the sun and moon 28′ 12″ with respect to the line of the nodes in every period, will wear it out in process of time; and after that, it will not return again in less than 12492 years.—These eclipses of the sun, which happen about the ascending node, and begin to come in at the north pole of the earth, will go a little southerly at each return, till they go quite off the earth at the south pole; and those which happen about the descending node, and begin to come in at the south pole of the earth, will go a little northerly at each return, till at last they quite leave the earth at the north pole.

To exemplify this matter, we shall first consider the sun's eclipse, (March 21st old style, April 1st new style), A. D. 1764, according to its mean revolutions, without equating the times, or the sun's distance from the node; and then according to its true equated times.

This eclipse fell in open space at each return, quite clear of the earth, even since the creation, till A. D. 1295, June 13th old style, at 12 h. 52 m. 59 sec. *post meridiem*, when the moon's shadow first touched the earth at the north pole; the sun being then 17° 48′ 27″ from the ascending node.—In each period since that time, the sun has come 28′ 12″ nearer and nearer the same node, and the moon's shadow has therefore gone more and more southerly.—In the year 1962, July 18th old style, at 10 h. 36 m. 21 sec. *p. m.* when the same eclipse will have returned 38 times, the sun will be only 24′ 45″ from the ascending node, and the centre of the moon's shadow will fall a little northward of the earth's centre. —At the end of the next following period, A D. 1980, July 28th old style, at 18 h. 19 m. 41 sec. *p m.* the sun will have receded back 3′ 27″ from the ascending node, and the moon will have a very small degree of southern latitude, which will cause the centre of her shadow to pass a very small matter south of the earth's centre.—After which, in every following period, the sun will be 28′ 12″ farther back from the ascending node than in the period last before; and the moon's shadow will go still farther and farther southward, until September 12th old style, at 23 h. 46 m. 22 sec. *p. m.* A. D. 2665; when the eclipse will have compleated its 77th periodical return, and will go quite off the earth at the south pole (the sun being then 17° 55′ 22″ back from the node) and cannot come in at the north pole, so as to begin the same course over again, in less than 12492 years afterward.—And such will be the case of every other eclipse of the sun: For, as there is about 18 degrees on each side of the node within which there is a possibility of eclipses, their whole revolution goes through 36 degrees about that node, which, taken from 360 degrees, leaves remaining 324 degrees for the eclipses to travel *in expansum*

panſum. And as this 36 degrees is not gone through in leſs than 77 periods, which takes up 1388 years, the remaining 324 degrees cannot be ſo gone through in leſs than 12492 years. For, as 36 is to 1388, ſo is 324 to 12492.

To illuſtrate this a little farther, we ſhall examine ſome of the moſt remarkable circumſtances of the returns of the eclipſe which happened July 14th 1748, about noon. This eclipſe, after traverſing the voids of ſpace from the creation, at laſt began to enter the Terra Auſtralis Incognita about 88 years after the conqueſt, which was the laſt of king Stephen's reign; every Chaldean period it has crept more northerly, but was ſtill inviſible in Britain before the year 1622; when, on the 30th of April, it began to touch the ſouth parts of England about 2 in the afternoon; its central appearance riſing in the American ſouth ſeas, and traverſing Peru and the Amazon's country, through the Atlantic ocean into Africa, and ſetting in the Æthiopian continent, not far from the beginning of the Red ſea.

Its next viſible period was after three Chaldean revolutions in 1676, on the firſt of June, riſing central in the Atlantic ocean, paſſing us about 9 in the morning, with four digits eclipſed on the under limb, and ſetting in the gulf of Cochinchina in the Eaſt Indies.

It being now near the ſolſtice, this eclipſe was viſible the very next return in 1694, in the evening; and in two periods more, which was in 1730, on the 4th of July, was ſeen about half eclipſed juſt after ſun-riſe, and obſerved both at Wirtemberg in Germany, and Pekin in China, ſoon after which it went off.

Eighteen years more afforded us the eclipſe which fell on the 14th of July 1748.

The next viſible return happened on July 25th 1766, in the evening, about four digits eclipſed; and after two periods more, will happen on Auguſt 16th 1802, early in the morning, about five digits, the centre coming from the north frozen continent, by the capes of Norway, through Tartary China and Japan, to the Ladrone iſlands, where it goes off.

Again, in 1820, Auguſt 26th, between one and two, there will be another great eclipſe at London, about 10 digits; but, happening ſo near the equinox, the centre will leave every part of Britain to the weſt, and enter Germany at Emden, paſſing by Venice, Naples, Grand Cairo, and ſet in the gulf of Baſſora near that city.

It will be no more viſible till 1874, when five digits will be obſcured (the centre being now about to leave the earth) on September 28th. In 1892, the ſun will go down eclipſed in London; and again, in 1928, the paſſage of the centre will be in the *expanſum*, though there will be two digits eclipſed at London, October the 31ſt of that year, and about the year 2090 the whole penumbra will be wore off; whence no more returns of this eclipſe can happen till after a revolution of 10 thouſand years.

From theſe remarks on the entire revolution of this eclipſe, we may gather, that a thouſand years, more or leſs, (for there are ſome irregularities that may protract or lengthen this period 100 years), complete the whole terreſtrial phenomena of any ſingle eclipſe: and ſince 20 periods of 54 years each, and about 33 days, comprehend the entire extent of their revolution, it is evident, that the times of the returns will paſs through a circuit of one year and ten months, every Chaldean period being ten or eleven days later, and of the equable appearances, about 32 or 33 days. Thus, though this eclipſe happens about the middle of July, no other ſubſequent eclipſe of this period will return till the middle of the ſame month again; but wear conſtantly each period 10 or 11 days forward, and at laſt appear in winter, but then it begins to ceaſe from affecting us.

Another concluſion from this revolution may be drawn, that there will ſeldom be any more than two great eclipſes of the ſun in the interval of this period, and theſe follow ſometimes next return, and often at greater diſtances. That of 1715 returned again in 1733 very great; but this preſent eclipſe will not be great till the arrival of 1820, which is a revolution of four Chaldean periods; ſo that the irregularities of their circuits muſt undergo new computations to aſſign them exactly.

Nor do all eclipſes come in at the ſouth pole: That depends altogether on the poſition of the lunar nodes, which will bring in as many from the *expanſum* one way as the other; and ſuch eclipſes will wear more ſoutherly by degrees, contrary to what happens in the preſent caſe.

The eclipſe, for example, of 1736 in September, had its centre in the *expanſum*, and ſet about the middle of its obſcurity in Britain; it will wear in at the north pole, and in the year 2600, or thereabouts, go off into the *expanſum* on the ſouth ſide of the earth.

The eclipſes therefore which happened about the creation are little more than half way yet of their etherial circuit; and will be 4000 years before they enter the earth any more. This grand revolution ſeems to have been intirely unknown to the ancients.

It is particularly to be noted, that eclipſes which have happened many centuries ago, will not be found by our preſent tables to agree exactly with ancient obſervations, by reaſon of the great anomalies in the lunar motions; which appears an inconteſtable demonſtration of the non-eternity of the univerſe. For it ſeems confirmed by undeniable proofs, that the moon now finiſhes her period in leſs time than formerly, and will continue, by the centripetal law, to approach nearer and nearer the earth, and to go ſooner and ſooner round it: Nor will the centrifugal power be ſufficient to compenſate the different gravitations of ſuch an aſſemblage of bodies as conſtitute the ſolar ſyſtem, which would come to ruin of itſelf, without ſome new regulation and adjuſtment of their original motions *.

We

* *There are two ancient eclipſes of the moon, recorded by Ptolemy from Hipparchus, which afford an undeniable proof of the moon's acceleration. The firſt of theſe was obſerved at Babylon, Decem. 22d, in the year before Chriſt 383; when the moon began to be eclipſed, about half an hour before the ſun roſe, and the eclipſe was not*

We are credibly informed from the teſtimony of the ancients, that there was a total eclipſe of the ſun predicted by Thales to happen in the fourth year of the 48th Olympiad, either at Sardis or Miletus in Aſia, where Thales then reſided. That year correſponds to the 585th year before Chriſt; when accordingly there happened a very ſignal eclipſe of the ſun, on the 28th of May, anſwering to the preſent 10th of that month, central through North America, the ſouth parts of France, Italy, *&c.* as far as Athens, or the iſles in the Ægean ſea; which is the fartheſt that even the Caroline tables carry it; and conſequently make it inviſible to any part of Aſia, in the total character; though there are good reaſons to believe that it extended to Babylon, and went down central over that city. We are not however to imagine, that it was ſet before it paſt Sardis and the Aſiatic towns, where the predictor lived; becauſe an inviſible eclipſe could have been of no ſervice to demonſtrate his ability in aſtronomical ſciences to his countrymen, as it could give no proof of its reality.

For a farther illuſtration, Thucydides relates, That a ſolar eclipſe happened on a ſummer's day in the afternoon, in the firſt year of the Peloponneſian war, ſo great, that the ſtars appeared. Rhodius was victor in the Olympic games the fourth year of the ſaid war, being alſo the fourth of the 87th Olympiad, on the 428th year before Chriſt. So that the eclipſe muſt have happened in the 431ſt year before Chriſt; and by computation it appears, that on the third of Auguſt there was a ſignal eclipſe which would have paſt over Athens, central about 6 in the evening, but which our preſent tables bring no farther than the ancient Syrtes on the African coaſt, above 400 miles from Athens; which ſuffering in that caſe but 9 digits, could by no means exhibit the remarkable darkneſs recited by this hiſtorian; the centre therefore ſeems to have paſt Athens about 6 in the evening, and probably might go down about Jeruſalem, or near it, contrary to the conſtruction of the preſent tables. Theſe things are only obviated by way of caution to the preſent aſtronomers, in re-computing ancient eclipſes; and they may examine the eclipſe of Nicias, ſo fatal to the Athenian fleet; that which overthrew the Macedonian army, *&c.*

In any year, the number of eclipſes of both luminaries cannot be leſs than two, nor more than ſeven; the moſt uſual number is four, and it is very rare to have more than ſix. For the ſun paſſes by both the nodes but once a-year, unleſs he paſſes by one of them in the beginning of the year; and if he does, he will paſs by the ſame node again a little before the year be finiſhed; becauſe, as theſe points move $19\frac{1}{3}$ degrees backward every year, the ſun will come to either of them 173 days after the other. And when either node is within 17 degrees of the ſun at the time of new moon, the ſun will be eclipſed. At the ſubſequent oppoſition, the moon will be eclipſed in the other node, and come round to the next conjunction again ere the former node be 17 degrees paſt the ſun, and will therefore eclipſe him again. When three eclipſes fall about either node, the like number generally falls about the oppoſite; as the ſun comes to it in 173 days afterward; and ſix lunations contain but four days more. Thus, there may be two eclipſes of the ſun, and one of the moon, about each of her nodes. But when the moon changes in either of the nodes, ſhe cannot be near enough the other node at the next full to be eclipſed; and in ſix lunar months afterward ſhe will change near the other node: in theſe caſes there can be but two eclipſes in a year, and they are both of the ſun.

A longer period than the above mentioned, for comparing and examining eclipſes which happen at long intervals of time, is 557 years, 21 days, 18 hours, 30 minutes, 11 ſeconds; in which time there are 6890 mean lunations; and the ſun and node meet again ſo nearly as to be but 11 ſeconds diſtant; but then it is not the ſame eclipſe that returns, as in the ſhorter period above mentioned.

A Liſt of Eclipſes, and hiſtorical Events, which happened about the ſame times, from RICCIOLUS.

Before CHRIST.			
754	July	5	But, according to an old kalendar, this eclipſe of the ſun was on the 21ſt of April, on which day the foundations of Rome were laid; if we may believe Taruntius Firmanus.
721	March	19	A total eclipſe of the moon. The Aſſyrian empire at an end; the Babylonian eſtabliſhed.

not over before the moon ſet: But, by moſt of our aſtronomical tables, the moon was ſet at Babylon half an hour before the eclipſe began; in which caſe, there could have been no poſſibility of obſerving it. The ſecond eclipſe was obſerved at Alexandria, Septem. 22d, the year before Chriſt 201; where the moon roſe ſo much eclipſed, that the eclipſe muſt have begun about half an hour before ſhe roſe: Whereas, by moſt of our tables, the beginning of this eclipſe was not till about 10 minutes after the moon roſe at Alexandria. Had theſe eclipſes begun and ended while the ſun was below the horizon, we might have imagined, that as the ancients had no certain way of meaſuring time, they might have been ſo far miſtaken in the hours, that we could not have laid any ſtreſs on the acounts given by them. But as, in the firſt eclipſe, the moon was ſet, and conſequently the ſun riſen, before it was over; and in the ſecond eclipſe the ſun was ſet, and the moon not riſen, till ſome time after it began; theſe are ſuch circumſtances as the obſervers could not poſſibly be miſtaken in. Mr Struyk, in the following catalogue, notwithſtanding the expreſs words of Ptolemy, puts down theſe two eclipſes as obſerved at Athens; where they might have been ſeen as above, without any acceleration of the moon's motion, Athens being 20 degrees weſt of Babylon, and 7 degrees weſt of Alexandria.

An

Fig. 1.

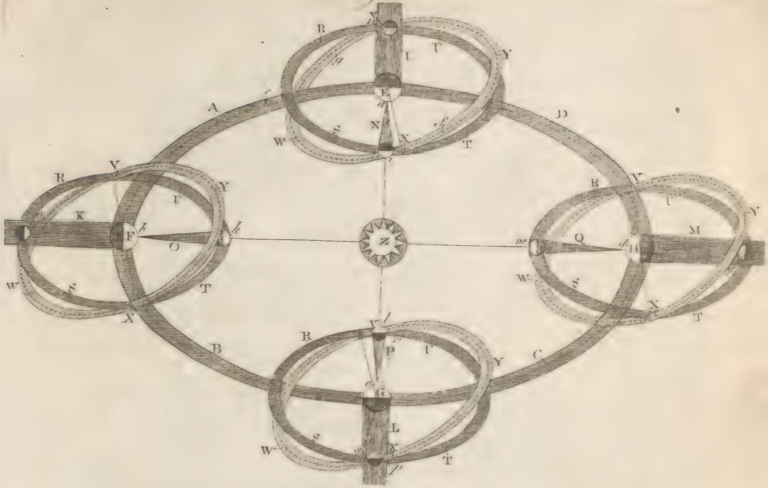


Fig. 2.

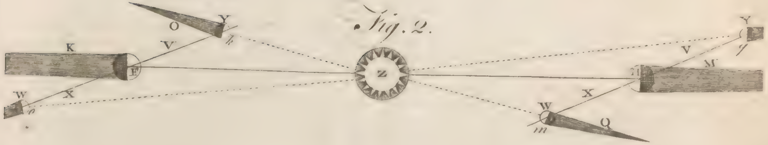
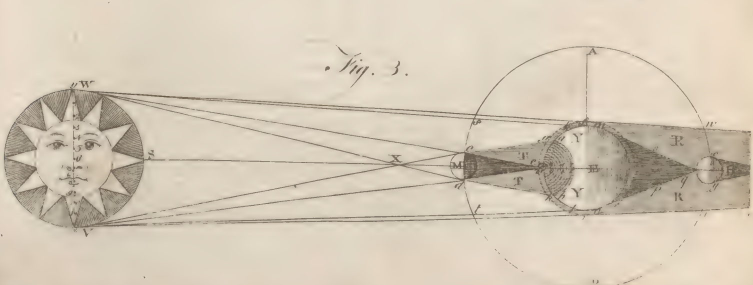


Fig. 3.



A. Bell Sculpt.

Before Christ.

585	May	28	An eclipſe of the ſun foretold by Thales, by which a peace was brought about between the Medes and Lydians.
523	July	16	An eclipſe of the moon, which was followed by the death of Cambyſes.
502	Nov.	19	An eclipſe of the moon, which was followed by the ſlaughter of the Sabines, and death of Valerius Publicola.
463	April	30	An eclipſe of the ſun. The Perſian war, and the falling off of the Perſians from the Egyptians.
431	April	25	An eclipſe of the moon, which was followed by a great famine at Rome; and the beginning of the Peloponneſian war.
431	Auguſt	3	A total eclipſe of the ſun. A comet and plague at Athens.
413	Auguſt	27	A total eclipſe of the moon. Nicias with his ſhip deſtroyed at Syracuſe.
394	Auguſt	14	An eclipſe of the ſun. The Perſians beat by Conon in a ſea-engagement.
168	June	21	A total eclipſe of the moon. The next day Perſeus, king of Macedonia, was conquered by Paulus Emilius.

After Chriſt.

59	April	30	An eclipſe of the ſun. This is reckoned among the prodigies, on account of the murder of Agrippinus by Nero.
237	April	12	A total eclipſe of the ſun. A ſign that the reign of the Gordiani would not continue long. A ſixth perſecution of the Chriſtians.
306	July	27	An eclipſe of the ſun. The ſtars were ſeen, and the emperor Conſtantius died.
840	May	4	A dreadful eclipſe of the ſun. And Lewis the Pious died within ſix months after it.
1009	———		An eclipſe of the ſun. And Jeruſalem taken by the Saracens.
1133	Auguſt	2	A terrible eclipſe of the ſun. The ſtars were ſeen. A ſchiſm in the church, occaſioned by there being three Popes at once.

We have not enumerated one half of Ricciolus's liſt of portentous eclipſes; and for the ſame reaſon that he declines giving any more of them than what that liſt contains, namely, that it is moſt diſagreeable to dwell any longer on ſuch nonſenſe: the ſuperſtition of the ancients may be ſeen by the few here copied.

Eclipſes of the ſun are more frequent than of the moon, becauſe the ſun's ecliptic limits are greater than the moon's; yet we have more viſible eclipſes of the moon than of the ſun, becauſe eclipſes of the moon are ſeen from all parts of that hemiſphere of the earth which is next her, and are equally great to each of thoſe parts; but the ſun's eclipſes are viſible only to that ſmall portion of the hemiſphere next him whereon the moon's ſhadow falls.

The moon's orbit being elliptical, and the earth in one of its focuſes, ſhe is once at her leaſt diſtance from the earth, and once at her greateſt, in every lunation. When the moon changes at her leaſt diſtance from the earth, and ſo near the node that her dark ſhadow falls upon the earth, ſhe appears big enough to cover the whole diſk of the ſun from that part on which her ſhadow falls; and the ſun appears totally eclipſed there for ſome minutes: but when the moon changes at her greateſt diſtance from the earth, and ſo near the node that her dark ſhadow is directed towards the earth, her diameter ſubtends a leſs angle than the ſun's; and therefore ſhe cannot hide his whole diſk from any part of the earth, nor does her ſhadow reach it at that time; and to the place over which the point of her ſhadow hangs, the eclipſe is annular, the ſun's edge appearing like a luminous ring all around the body of the moon. When the change happens within 17 degrees of the node, and the moon at her mean diſtance from the earth, the point of her ſhadow juſt touches the earth, and ſhe eclipſeth the ſun totally to that ſmall ſpot whereon her ſhadow falls; but the darkneſs is not of a moment's continuance.

The moon's apparent diameter, when largeſt, exceeds the ſun's, when leaſt, only 1 minute 38 ſeconds of a degree; and in the greateſt eclipſe of the ſun that can happen at any time and place, the total darkneſs continues no longer than whilſt the moon is going 1 minute 38 ſeconds from the ſun in her orbit, which is about 3 minutes and 13 ſeconds of an hour.

The moon's dark ſhadow covers only a ſpot on the earth's ſurface, about 180 Engliſh miles broad, when the moon's diameter appears largeſt, and the ſun's leaſt; and the total darkneſs can extend no farther than the dark ſhadow covers. Yet the moon's partial ſhadow or penumbra may then cover a circular ſpace 4900 miles in diameter, within all which the ſun is more or leſs eclipſed, as the places are leſs or more diſtant from the centre of the penumbra. When the moon changes exactly in the node, the penumbra is circular on the earth at the middle of the general eclipſe; becauſe at that time it falls perpendicularly on the earth's ſurface; but at every other moment it falls obliquely, and will therefore be elliptical; and the more ſo, as the time is longer before or after the middle of the general eclipſe; and then, much greater portions of the earth's ſurface are involved in the penumbra.

When the penumbra firſt touches the earth, the general eclipſe begins; when it leaves the earth, the general eclipſe ends: from the beginning to the end the ſun appears eclipſed in ſome part of the earth or other. When the penumbra touches any place, the eclipſe begins at that place, and ends when the penumbra leaves it. When the moon changes in the node, the penumbra goes

goes over the centre of the earth's disk as seen from the moon; and consequently, by describing the longest line possible on the earth, continues the longest upon it; namely, at a mean rate, 5 hours 50 minutes; more, if the moon be at her greatest distance from the earth, because she then moves slowest; less, if she be at her least distance, because of her quicker motion.

To make several of the above and other phenomena plainer, (Plate XLVI. fig. 3.), let *S* be the sun, *E* the the earth, *M* the moon, and *AMP* the moon's orbit. Draw the right line *Wc* 12 from the western side of the sun at *W*, touching the western side of the moon at *c*, and the earth at 12: draw also the right line *Vd* 12 from the eastern side of the sun at *V*, touching the eastern side of the moon at *d*, and the earth at 12: the dark space *ce*12*d* included between those lines is the moon's shadow, ending in a point at 12, where it touches the earth; because in this case the moon is supposed to change at *M* in the middle between *A* the apogee, or farthest point of her orbit from the earth, and *P* the perigee, or nearest point to it. For, had the point *P* been at *M*, the moon had been nearer the earth; and her dark shadow at *e* would have covered a space upon it about 180 miles broad, and the sun would have been totally darkened, with some continuance: but had the point *A* been at *M*, the moon would have been farther from the earth, and her shadow would have ended in a point about *e*, and therefore the sun would have appeared like a luminous ring all around the moon. Draw the right lines *WXdb* and *VXcg*, touching the contrary sides of the sun and moon, and ending on the earth at *a* and *b*: draw also the right line *SXM*12, from the centre of the sun's disk, through the moon's centre, to the earth at 12; and suppose the two former lines *WXdb* and *VXcg* to revolve on the line *SXM*12 as an axis, and their points *a* and *b* will describe the limits of the penumbra *TT* on the earth's surface, including the large space *aob*12*a*; within which the sun appears more or less eclipsed, as the places are more or less distant from the verge of the penumbra *aob*.

Draw the right line *y*12 across the sun's disk, perpendicular to *SXM* the axis of the penumbra: then divide the line *y*12 into twelve equal parts, as in the figure, for the twelve digits or equal parts of the sun's diameter; and, at equal distances from the centre of the penumbra at 12 (on the earth's surface *YY*) to its edge *aob*, draw twelve concentric circles, as marked with the numeral figures 1 2 3 4 &c. and remember that the moon's motion in her orbit *AMP* is from west to east, as from *s* to *t*. Then,

To an observer on the earth at *b*, the eastern limb of the moon at *d* seems to touch the western limb of the sun at *W*, when the moon is at *M*; and the sun's eclipse begins at *b*, appearing as at *A* in Plate XLVII. fig. 1. at the left hand; but, at the same moment of absolute time to an observer at *a* in Plate XLVI. fig. 3. the western edge of the moon at *c* leaves the eastern edge of the sun at *V*, and the eclipse ends, as at the right hand *C*, Plate XLVII. fig 1. At the very same instant, to all those who live on the circle marked 1 on the earth *E*, in Plate XLVI. fig. 3. the moon *M* cuts off or darkens a twelfth part of the sun *S*, and eclipses him one digit, as at 1 in Plate XLVII. fig. 1.: to those who live on the circle marked 2 in Plate XLVI. fig. 3. the moon cuts off two twelfth parts of the sun, as at 2 in Plate XLVII. fig. 1.; to those on the circle 3, three parts; and so on to the centre at 12 in Plate XLVI. fig. 3. where the sun is centrally eclipsed, as at *B* in the middle of fig. 1. Plate XLVII.; under which figure there is a scale of hours and minutes, to shew at a mean state how long it is from the beginning to the end of a central eclipse of the sun on the parallel of London; and how many digits are eclipsed at any particular time from the beginning at *A* to the middle at *B*, or the end at *C*. Thus, in 16 minutes from the beginning, the sun is two digits eclipsed; in an hour and five minutes, eight digits; and in an hour and 37 minutes, 12 digits.

By Plate XLVI. fig. 3. it is plain, that the sun is totally or centrally eclipsed but to a small part of the earth at any time; because the dark conical shadow *e* of the moon *M* falls but on a small part of the earth; and that the partial eclipse is confined at that time to the space included by the circle *aob*, of which only one half can be projected in the figure, the other half being supposed to be hid by the convexity of the earth *E*: and likewise, that no part of the sun is eclipsed to the large space *YY* of the earth, because the moon is not between the sun and any of that part of the earth: and therefore to all that part the eclipse is invisible. The earth turns eastward on its axis, as from *g* to *h*, which is the same way that the moon's shadow moves; but the moon's motion is much swifter in her orbit from *s* to *t*: and therefore, although eclipses of the sun are of longer duration on account of the earth's motion on its axis than they would be if that motion was stopt, yet, in four minutes of time at most, the moon's swifter motion carries her dark shadow quite over any place that its centre touches at the time of greatest obscuration. The motion of the shadow on the earth's disk is equal to the moon's motion from the sun, which is about 30½ minutes of a degree every hour at a mean rate; but so much of the moon's orbit is equal to 30½ degrees of a great circle on the earth; and therefore the moon's shadow goes 30½ degrees. or 1830 geographical miles on the earth in an hour, or 30½ miles in a minute, which is almost four times as swift as the motion of a cannon-ball.

As seen from the sun or moon, the earth's axis appears differently inclined every day of the year, on account of keeping its parallelism throughout its annual course. In Plate XLVII. fig. 2. let *EDON* be the earth at the two equinoxes and the two solstices, *NS* its axis, *N* the north pole, *S* the south pole, *ÆQ* the equator, *T* the tropic of Cancer, *t* the tropic of Capricorn, and *ABC* the circumference of the earth's enlightened disk as seen from the sun or new moon at these times. The earth's axis has the position *NES* at the vernal equinox, lying towards the right hand, as seen from the sun or new moon; its poles *N* and *S* being then in the circumference of the disk; and the equator and all its parallels seem to be straight lines, because their planes pass through the observer's eye looking down upon the earth from the sun or moon directly over *E*, where the ecliptic *FG* intersects the equator *Æ*. At the summer solstice, the earth's axis has the position *NDS*; and

and that part of the ecliptic *FG*, in which the moon is then new, touches the tropic of Cancer *T* at *D*. The north pole *N* at that time, inclining 23½ degrees towards the fun, falls fo many degrees within the earth's enlightened difk, becaufe the fun is then vertical to *D*, 23½ degrees north of the equator *ÆQ*; and the equator with all its parallels feem elliptic curves bending downward, or towards the fouth pole, as feen from the fun; which pole, together with 23½ degrees all round it, is hid behind the difk in the dark hemifphere of the earth. At the autumnal equinox, the earth's axis has the pofition *NOS*, lying to the left hand as feen from the fun or new moon, which are then vertical to *O*, where the ecliptic cuts the equator *ÆQ*. Both poles now lie in the circumference of the difk, the north pole juft going to difappear behind it, and the fouth pole juft entering into it; and the equator, with all its parallels, feem to be ftraight lines, becaufe their planes pafs through the obferver's eye, as feen from the fun, and very nearly fo as feen from the moon. At the winter folftice, the earth's axis has the pofition *NNS*; when its fouth pole *S* inclining 23½ degrees toward the fun, falls 23½ degrees within the enlightened difk, as feen from the fun or new moon, which are then vertical to the tropic of Capricorn *t*, 23½ degrees fouth of the equator *ÆQ*; and the equator, with all its parallels, feem elliptic curves bending upward; the north pole being as far hid behind the difk in the dark hemifphere, as the fouth pole is come into the light. The nearer that any time of the year is to the equinoxes or folftices, the more it partakes of the phenomena relating to them.

Thus it appears, that from the vernal equinox to the autumnal, the north pole is enlightened; and the equator, and all its parallels, appear elliptical as feen from the fun, more or lefs curved as the time is nearer to, or farther from, the fummer folftice; and bending downwards, or towards the fouth pole; the reverfe of which happens from the autumnal equinox to the vernal. A little confideration will be fufficient to convince the reader, that the earth's axis inclines towards the fun at the fummer folftice; from the fun at the winter folftice; and fidewife to the fun at the equinoxes; but towards the right hand, as feen from the fun at the vernal equinox; and towards the left hand at the autumnal. From the winter to the fummer folftice, the earth's axis inclines more or lefs to the right hand, as feen from the fun; and the contrary from the fummer to the winter folftice.

The different pofitions of the earth's axis, as feen from the fun at different times of the year, affect folar eclipfes greatly with regard to particular places; yea, fo far as would make central eclipfes which fall at one time of the year invifible if they fell at another, even though the moon fhould always change in the nodes, and at the fame hour of the day; of which indefinitely various affections, we fhall only give examples for the times of the equinoxes and folftices.

In the fame diagram, (Plate XLVII. fig. 2.), let *FG* be part of the ecliptic, and *IK*, *ik*, *ik*, *ik*, part of the moon's orbit; both feen edgewife, and therefore projected into right lines; and let the interfections *NODE* be one and the fame node at the above times, when the earth has the forementioned different pofitions; and let the fpaces included by the circles *Pppp* be the penumbra at thefe times, as its centre is paffing over the centre of the earth's difk. At the winter folftice, when the earth's axis has the pofition *NNS*, the centre of the penumbra *P* touches the tropic of Capricorn *t* in *N* at the middle of the general eclipfe; but no part of the penumbra touches the tropic of Cancer *T*. At the fummer folftice, when the earth's axis has the pofition *NDS* (*iDk* being then part of the moon's orbit, whofe node is at *D*) the penumbra *p* has its centre at *D*, on the tropic of Cancer *T*, at the middle of the general eclipfe, and then no part of it touches the tropic of Capricorn *t*. At the autumnal equinox, the earth's axis has the pofition *NOS*, (*iOk* being then part of the moon's orbit), and the penumbra equally includes part of both tropics *T* and *t* at the middle of the general eclipfe: at the vernal equinox it does the fame, becaufe the earth's axis has the pofition *NES*; but, in the former of thefe two laft cafes, the penumbra enters the earth at *A*, north of the tropic of Cancer *T*, and leaves it at *m*, fouth of the tropic of Capricorn *t*; having gone over the earth obliquely fouthward, as its centre defcribed the line *AOm*: whereas, in the latter cafe, the penumbra touches the earth at *n*, fouth of the equator *ÆQ*, and defcribing the line *nEq*, (fimilar to the former line *AOm* in open fpace), goes obliquely northward over the earth, and leaves it at *q*, north of the equator.

In all thefe circumftances, the moon has been fuppofed to change at noon in her defcending node: Had fhe changed in her afcending node, the phenomena would have been as various the contrary way, with refpect to the penumbra's going northward or fouthward over the earth. But becaufe the moon changes at all hours, as often in one node as in the other, and at all diftances from them both at different times as it happens, the variety of the phafes of eclipfes are almoft innumerable, even at the fame places; confidering alfo how varioufly the fame places are fituated on the enlightened difk of the earth, with refpect to the penumbra's motion, at the different hours when eclipfes happen.

When the moon changes 17 degrees fhort of her defcending node, the penumbra *P* 18 juft touches the northern part of the earth's difk, near the north pole *N*; and, as feen from that place, the moon appears to touch the fun, but hides no part of him from fight. Had the change been as far fhort of the afcending node, the penumbra would have touched the fouthern part of the difk near the fouth pole *S*. When the moon changes 12 degrees fhort of the defcending node, more than a third part of the penumbra *P*12 falls on the northern parts of the earth at the middle of the general eclipfe: Had fhe changed as far paft the fame node, as much of the other fide of the penumbra about *P* would have fallen on the fouthern part of the earth; all the reft in the *expanfum*, or open fpace. When the moon changes 6 degrees from the node, almoft the whole penumbra *P*6 falls on the earth at the middle of the general eclipfe. And laftly, when the moon changes in the node at *N*, the penumbra *PN* takes the longeft courfe poffible on the earth's difk; its centre

centre falling on the middle thereof, at the middle of the general eclipſe. The farther the moon changes from either node, within 17 degrees of it, the ſhorter is the penumbra's continuance on the earth, becauſe it goes over a leſs portion of the diſk, as is evident by the figure.

The nearer that the penumbra's centre is to the equator at the middle of the general eclipſe, the longer is the duration of the eclipſe at all thoſe places where it is central; becauſe, the nearer that any place is to the equator, the greater is the circle it deſcribes by the earth's motion on its axis: And ſo, the place moving quicker, keeps longer in the penumbra, whoſe motion is the ſame way with that of the place, though faſter, as has been already mentioned. Thus (ſee the earth at *D* and the penumbra at 12) whilſt the point *b* in the polar circle *abcd* is carried from *b* to *c* by the earth's diurnal motion, the point *d* on the tropic of Cancer *T* is carried a much greater length from *d* to *D*; and therefore, if the penumbra's centre goes one time over *c* and another time over *D*, the penumbra will be longer in paſſing over the moving place *d* than it was in paſſing over the moving place *b*. Conſequently, central eclipſes about the poles are of the ſhorteſt duration; and about the equator of the longeſt.

In the middle of ſummer, the whole frigid zone, included by the polar circle *abcd*, is enlightened; and if it then happens, that the penumbra's centre goes over the north pole, the ſun will be eclipſed much the ſame number of digits at *a* as at *c*; but whilſt the penumbra moves eaſtward over *c*, it moves weſtward over *a*; becauſe, with reſpect to the penumbra, the motions of *a* and *c* are contrary: For *c* moves the ſame way with the penumbra towards *d*, but *a* moves the contrary way towards *b*; and therefore the eclipſe will be of longer duration at *c* than at *a*. At *a* the eclipſe begins on the ſun's eaſtern limb, but at *c* on his weſtern: At all places lying without the polar circles, the ſun's eclipſes begin on his weſtern limb, or near it, and end on or near his eaſtern. At thoſe places where the penumbra touches the earth, the eclipſe begins with the riſing ſun, on the top of his weſtern or uppermoſt edge; and at thoſe places where the penumbra leaves the earth, the eclipſe ends with the ſetting ſun, on the top of his eaſtern edge, which is then the uppermoſt, juſt at its diſappearing in the horizon.

If the moon were ſurrounded by an atmoſphere of any conſiderable denſity, it would ſeem to touch the ſun a little before the moon made her appulſe to his edge, and we ſhould ſee a little faintneſs on that edge before it were eclipſed by the moon: But as no ſuch faintneſs has been obſerved, it ſeems plain, that the moon has no ſuch atmoſphere as that of the earth. The faint ring of light ſurrounding the ſun in total eclipſes, called by Caſſini *la chevelure du ſoleil*, ſeems to be the atmoſphere of the ſun; becauſe it has been obſerved to move equally with the ſun, not with the moon.

Having been ſo prolix concerning eclipſes of the ſun, we ſhall drop that ſubject at preſent, and proceed to the doctrine of lunar eclipſes; which, being more ſimple, may be explained in leſs time.

That the moon can never be eclipſed but at the time of her being full, and the reaſon why ſhe is not eclipſed at every full, has been ſhewn already. In Plate XLVI. fig. 3. let *S* be the ſun, *E* the earth, *RR* the earth's ſhadow, and and *B* the moon in oppoſition to the ſun: In this ſituation the earth intercepts the ſun's light in its way to the moon; and when the moon touches the earth's ſhadow at *v*, ſhe begins to be eclipſed on her eaſtern limb *x*, and continues eclipſed until her weſtern limb *y* leaves the ſhadow at *w*: At *B* ſhe is in the middle of the ſhadow, and conſequently in the middle of the eclipſe.

The moon, when totally eclipſed, is not inviſible if ſhe be above the horizon and the ſky be clear; but appears generally of a duſky colour, like tarniſhed copper, which ſome have thought to be the moon's native light. But the true cauſe of her being viſible is the ſcattered beams of the ſun, bent, into the earth's ſhadow by going through the atmoſphere; which, being more or leſs denſe near the earth than at conſiderable heights above it, refracts or bends the ſun's rays more inward, the nearer they are paſſing by the earth's ſurface, than thoſe rays which go through higher parts of the atmoſphere, where it is leſs denſe according to its height, until it be ſo thin or rare as to loſe its refractive power. Let the circle *fghi*, concentric to the earth, include the atmoſphere whoſe refractive power vaniſhes at the heights *f* and *i*; ſo that the rays *Wfw* and *Viv* go on ſtraight without ſuffering the leaſt refraction: But all thoſe rays which enter the atmoſphere between *f* and *k*, and between *i* and *l*, on oppoſite ſides of the earth, are gradually more bent inward as they go through a greater portion of the atmoſphere, until the rays *Wk* and *Vl* touching the earth at *m* and *n*, are bent ſo much as to meet at *q*, a little ſhort of the moon; and therefore the dark ſhadow of the earth is contained in the ſpace *moqpn*, where none of the ſun's rays can enter: All the reſt *RR*, being mixed by the ſcattered rays which are refracted as above, is in ſome meaſure enlightened by them; and ſome of thoſe rays falling on the moon, give her the colour of tarniſhed copper, or of iron almoſt red hot. So that if the earth had no atmoſphere, the moon would be as inviſible in total eclipſes as ſhe is when new. If the moon were ſo near the earth as to go into its dark ſhadow, ſuppoſe about *po*, ſhe would be inviſible during her ſtay in it; but viſible before and after in the fainter ſhadow *RR*.

When the moon goes through the centre of the earth's ſhadow, ſhe is directly oppoſite to the ſun: Yet the moon has been often ſeen totally eclipſed in the horizon when the ſun was alſo viſible in the oppoſite part of it: For, the horizontal refraction being almoſt 34 minutes of a degree, and the diameter of the ſun and moon being each at a mean ſtate but 32 minutes, the refraction cauſes both luminaries to appear above the horizon when they are really below it.

When the moon is full at 12 degrees from either of her nodes, ſhe juſt touches the earth's ſhadow, but enters not into it. In Plate XLVII. fig. 3. let *GH* be the ecliptic, *ef* the moon's orbit where ſhe is 12 degrees from the node at her full; *cd* her orbit where ſhe is 6 degrees from the node, *ab* her orbit where ſhe is full in the node, *AB* the earth's ſhadow, and *M* the moon. When the

the moon describes the line *ef*, she just touches the shadow, but does not enter into it; when she describes the line *cd*, she is totally, though not centrally, immersed in the shadow; and when she describes the line *ab*, she passes by the node at *M* in the centre of the shadow, and takes the longest line possible, which is a diameter, thro' it: And such an eclipse being both total and central is of the longest duration, namely, 3 hours 57 minutes 6 seconds from the beginning to the end, if the moon be at her greatest distance from the earth; and 3 hours 37 minutes 26 seconds, if she be at her least distance. The reason of this difference is, that when the moon is farthest from the earth, she moves slowest; and when nearest to it, quickest.

The moon's diameter, as well as the sun's, is supposed to be divided into twelve equal parts, called *digits*; and so many of these parts as are darkened by the earth's shadow, so many digits is the moon eclipsed. All that the moon is eclipsed above 12 digits, shew how far the shadow of the earth is over the body of the moon, on that edge to which she is nearest at the middle of the eclipse.

It is difficult to observe exactly either the beginning or ending of a lunar eclipse, even with a good telescope; because the earth's shadow is so faint and ill defined about the edges, that when the moon is either just touching or leaving it, the obscuration of her limb is scarce sensible; and therefore the nicest observers can hardly be certain to four or five seconds of time. But both the beginning and ending of solar eclipses are visibly instantaneous; for the moment that the edge of the moon's disk touches the sun's, his roundness seems a little broke on that part; and the moment she leaves it, he appears perfectly round again.

In astronomy, eclipses of the moon are of great use for ascertaining the periods of her motions; especially such eclipses as are observed to be alike in all her circumstances, and have long intervals of time between them. In geography, the longitudes of places are found by eclipses: But for this purpose eclipses of the moon are more useful than those of the sun, because they are more frequently visible, and the same lunar eclipse is of equal largeness and duration at all places where it is seen. In chronology, both solar and lunar eclipses serve to determine exactly the time of any past event: for there are so many particulars observable in every eclipse, with respect to its quantity, the places where it is visible (if of the sun) and the time of the day or night, that it is impossible there can be two solar eclipses in the course of many ages which are alike in all circumstances.

From the above explanation of the doctrine of eclipses it is evident, that the darkness at our Saviour's crucifixion was supernatural. For he suffered on the day on which the passover was eaten by the Jews, on which day it was impossible that the moon's shadow could fall on the earth; for the Jews kept the passover at the time of full moon: Nor does the darkness in total eclipses of the sun last above four minutes in any place; whereas the darkness at the crucifixion lasted three hours, Matth. xxviii. 15. and overspread at least all the land of Judea.

With regard to the method of calculating and projecting eclipses, we must refer the reader to the astronomical tables of Mr Ferguson and others. When the principles are explained, the application and use of the tables is a matter of small difficulty, and easily acquired by a little practice.

Chap. XVII. *Of the fixed Stars.*

The stars are said to be fixed, because they have been generally observed to keep at the same distances from each other: their apparent diurnal revolutions being caused solely by the earth's turning on its axis. They appear of a sensible magnitude to the bare eye, because the retina is affected not only by the rays of light which are emitted directly from them, but by many thousands more, which, falling upon our eye-lids, and upon the aerial particles about us, are reflected into our eyes so strongly as to excite vibrations not only in those points of the retina where the real images of the stars are formed, but also in other points at some distance round about. This makes us imagine the stars to be much bigger than they would appear, if we saw them only by the few rays which come directly from them, so as to enter our eyes without being intermixed with others. Any one may be sensible of this, by looking at a star of the first magnitude through a long narrow tube; which, though it takes in as much of the sky as would hold a thousand such stars, yet scarce renders *that* one visible.

The more a telescope magnifies, the less is the aperture through which the star is seen; and consequently the fewer rays it admits into the eye. Now since the stars appear less in a telescope which magnifies 200 times, than they do to the bare eye, insomuch that they seem to be only indivisible points, it proves at once that the stars are at immense distances from us, and that they shine by their own proper light. If they shone by borrowed light, they would be as invisible without telescopes as the satellites of Jupiter are; for these satellites appear bigger when viewed with a good telescope than the largest fixed stars do.

The number of stars discoverable, in either hemisphere, by the naked eye, is not above a thousand. This at first may appear incredible, because they seem to be without number: But the deception arises from our looking confusedly upon them, without reducing them into order. For, look but stedfastly upon a pretty large portion of the sky, and count the number of stars in it, and you will be surprised to find them so few. Or, if one considers how seldom the moon meets with any stars in her way, although there are as many about her path as in other parts of the heavens, he will soon be convinced that the stars are much thinner sown than he was aware of. The British catalogue, which, besides the stars visible to the bare eye, includes a great number which cannot be seen without the assistance of a telescope, contains no more than three thousand, in both hemispheres.

As we have incomparably more light from the moon than from all the stars together, it were the greatest absurdity

ſurdity to imagine that the ſtars were made for no other purpoſe than to caſt a faint light upon the earth; eſpecially ſince many more require the aſſiſtance of a good teleſcope to find them out, than are viſible without that inſtrument. Our ſun is ſurrounded by a ſyſtem of planets and comets; all which would be inviſible from the neareſt fixed ſtar. And from what we already know of the immenſe diſtance of the ſtars, the neareſt may be computed at 32,000,000,000,000 of miles from us, which is farther than a cannon-bullet would fly in 7,000,000 of years. Hence it is eaſy to prove, that the ſun, ſeen from ſuch a diſtance, would appear no bigger than a ſtar of the firſt magnitude. From all this it is highly probable, that each ſtar is a ſun to a ſyſtem of worlds moving round it, though unſeen by us; eſpecially as the doctrine of a plurality of worlds is rational, and greatly manifeſts the power, wiſdom, and goodneſs of the great Creator.

The ſtars, on account of their apparently various magnitudes, have been diſtributed into ſeveral claſſes, or orders. Thoſe which appear largeſt, are called *ſtars of the firſt magnitude*; the next to them in luſtre, *ſtars of the ſecond magnitude*; and ſo on the *ſixth*, which are the ſmalleſt that are viſible to the bare eye. This diſtribution having been made long before the invention of teleſcopes, the ſtars which cannot be ſeen without the aſſiſtance of theſe inſtruments, are diſtinguiſhed by the name of *teleſcopic ſtars*.

The ancients divided the ſtarry ſphere into particular conſtellations, or ſyſtems of ſtars, according as they lay near one another, ſo as to occupy thoſe ſpaces which the figures of different ſorts of animals or things would take up, if they were there delineated. And thoſe ſtars which could not be brought into any particular conſtellation, were called *unformed ſtars*.

This diviſion of the ſtars into different conſtellations or aſteriſms, ſerves to diſtinguiſh them from one another, ſo that any particular ſtar may be readily found in the heavens by means of a celeſtial globe; on which the conſtellations are ſo delineated, as to put the moſt remarkable ſtars into ſuch parts of the figures as are moſt eaſily diſtinguiſhed. The number of the ancient conſtellations is 48, and upon our preſent globes about 70. On Senex's globes are inſerted Bayer's letters; the firſt in the Greek alphabet being put to the biggeſt ſtar in each conſtellation, the ſecond to the next, and ſo on: By which means, every ſtar is as eaſily found as if a name were given to it. Thus, if the ſtar γ in the conſtellation of the ram be mentioned, every aſtronomer knows as well what ſtar is meant as if it were pointed out to him in the heavens.

There is alſo a diviſion of the heavens into three parts. 1. The Zodiak (ζωδιακος) from ζωδιον, *zodion*, an animal, becauſe moſt of the conſtellations in it, which are twelve in number, are the figures of animals: As *Aries* the ram, *Taurus* the bull, *Gemini* the twins, *Cancer* the crab, *Leo* the lion, *Virgo* the virgin, *Libra* the balance, *Scorpio* the ſcorpion, *Sagittarius* the archer, *Capricornus* the goat, *Aquarius* the water-bearer, and *Piſces* the fiſhes. The zodiac goes quite round the heavens: it is about 16 degrees broad, ſo that it takes in the orbits of all the planets, and likewiſe the orbit of the moon. Along the middle of this zone or belt is the ecliptic, or circle which the earth deſcribes annually as ſeen from the ſun; and which the ſun appears to deſcribe as ſeen from the earth. 2. All that region of the heavens, which is on the north ſide of the zodiac, containing twenty-one conſtellations. And, 3. That on the ſouth ſide, containing fifteen.

The ancients divided the zodiac into the above twelve conſtellations or ſigns in the following manner. They took a veſſel with a ſmall hole in the bottom, and having filled it with water, ſuffered the ſame to diſtil drop by drop into another veſſel ſet beneath to receive it; beginning at the moment when ſome ſtar roſe, and continuing until it roſe the next following night. The water fallen down into the receiver they divided into twelve equal parts; and having two other ſmall veſſels in readineſs, each of them fit to contain one part, they again poured all the water into the upper veſſel, and obſerving the riſing of ſome ſtar in the zodiac, they at the ſame time ſuffered the water to drop into one of the ſmall veſſels; and as ſoon as it was full, they ſhifted it, and ſet an empty one in its place. When each veſſel was full, they took notice what ſtar of the zodiac roſe; and though this could not be done in one night, yet in many they obſerved the riſing of twelve ſtars or points, by which they divided the zodiac into twelve parts.

The names of the conſtellations, and the number of ſtars obſerved in each of them by different aſtronomers, are as follow.

The ancient Conſtellations.		*Ptolemy.*	*Tycho.*	*Hevelius.*	*Flamſteed.*
Urſa minor	The Little Bear	8	7	12	24
Urſa major	The Great Bear	35	29	73	87
Draco	The Dragon	31	32	40	80
Cepheus	Cepheus	13	4	51	35
Bootes, *Arctophilax*		23	18	52	54
Corona Borealis	The Northern Crown	8	8	8	21
Hercules, *Engonaſin*	Hercules kneeling	29	28	45	113
Lyra	The Harp	10	11	17	21
Cygnus, *Gallina*	The Swan	19	18	47	81
Caſſiopea	The Lady in her Chair	13	26	37	55
Perſeus	Perſeus	29	29	46	59
Auriga	The Waggoner	14	9	40	66
Serpentarius, *Ophiuchus*	Serpentarius	29	15	40	74

Serpens

The ancient Constellations.		Ptolemy.	Tycho.	Hevelius.	Flamsteed.
Serpens	The Serpent	18	13	22	64
Sagitta	The Arrow	5	5	5	18
Aquila, *Vultur*	The Eagle }	15	12	23	71
Antinous	Antinous }		3	19	
Delphinus	The Dolphin	10	10	14	18
Equulus, *Equi sectio*	The Horse's Head	4	4	6	10
Pegasus, *Equus*	The Flying Horse	20	19	38	89
Andromeda	Andromeda	23	23	47	66
Triangulum	The Triangle	4	4	12	16
Aries	The Ram	18	21	27	66
Taurus	The Bull	44	43	51	141
Gemini	The Twins	25	25	38	85
Cancer	The Crab	23	15	29	83
Leo	The Lion }	35	30	49	95
Coma Berenices	Berenice's Hair }		14	21	43
Virgo	The Virgin	32	33	50	110
Libra, *Chelæ*	The Scales	17	10	20	51
Scorpius	The Scorpion	24	10	20	44
Sagittarius	The Archer	31	14	22	69
Capricornus	The Goat	28	28	29	51
Aquarius	The Water-bearer	45	41	47	108
Pisces	The Fishes	38	36	39	113
Cetus	The Whale	22	21	45	97
Orion	Orion	38	42	62	78
Eridanus, *Fluvius*	Eridanus, *the River*	34	10	27	84
Lepus	The Hare	12	13	16	19
Canis major	The Great Dog	29	13	21	31
Canis minor	The Little Dog	2	2	13	14
Argo Navis	The Ship	45	3	4	64
Hydra	The Hydra	27	19	31	60
Crater	The Cup	7	3	10	31
Corvus	The Crow	7	4		9
Centaurus	The Centaur	37			35
Lupus	The Wolf	19			24
Ara	The Altar	7			9
Corona Australis	The Southern Crown	13			12
Piscis Australis	The Southern Fish	18			24

The new Southern Constellations.

Columba Noachi	Noah's Dove	10
Robur Carolinum	The Royal Oak	12
Grus	The Crane	13
Phœnix	The Phenix	13
Indus	The Indian	12
Pavo	The Peacock	14
Apus, *Avis Indica*	The Bird of Paradise	11
Apis, *Musca*	The Bee or Fly	4
Chamæleon	The Chameleon	10
Triangulum Australis	The South Triangle	5
Piscis volans, *Passer*	The Flying Fish	8
Dorado, *Xiphias*	The Sword Fish	6
Toucan	The American Goose	9
Hydrus	The Water Snake	10

Hevelius's Constellations made out of the unformed Stars.

		Hevel.	Flamst.
Lynx	The Lynx	19	44
Leo minor	The Little Lion		53
Asterion & Chara	The Greyhounds	23	25
Cerberus	Cerberus	4	
Vulpecula & Anser	The Fox and Goose	27	35
Scutum Sobieski	Sobieski's Shield	7	
Lacerta	The Lizard	10	16
Camelopardalus	The Camelopard	32	58
Monocerns	The Unicorn	19	31
Sextans	The Sextant	11	41

There is a remarkable track round the heavens, called the *Milky Way*, from its peculiar whiteness, which was formerly thought to be owing to a vast number of very small stars therein: but the telescope shews it to be quite otherwise; and therefore its whiteness must be owing to some other cause. This track appears single in some parts, in others double.

There are several little whitish spots in the heavens, which appear magnified, and more luminous when seen through telescopes; yet without any stars in them. One of these is in Andromeda's girdle, and was first observed *A. D.* 1612, by Simon Marius: it has some whitish rays

rays near its middle, is liable to feveral changes, and is fometimes invifible. Another is near the ecliptic, between the head and bow of Sagittarius: it is fmall, but very luminous. A third is on the back of the Centaur, which is too far fouth to be feen in Britain. A fourth, of a fmaller fize, is before Antinous's right foot; having a ftar in it, which makes it appear more bright. A fifth is in the conftellation of Hercules, between the ftars ζ and η, which fpot, though but fmall, is vifible to the bare eye, if the fky be clear and the moon abfent.

Cloudy ftars are fo called from their mifty appearance. They look like dim ftars to the naked eye; but through a telefcope they appear broad illuminated parts of the fky; in fome of which is one ftar, in others more. Five of thefe are mentioned by Ptolemy. 1. One at the extremity of the right hand of Perfeus. 2. One in the middle of the Crab. 3. One unformed, near the fting of the Scorpion. 4. The eye of Sagittarius. 5. One in the head of Orion. In the firft of thefe appear more ftars through the telefcope than in any of the reft, although 21 have been counted in the head of Orion, and above 40 in that of the Crab. Two are vifible in the eye of Sagittarius without a telefcope, and feveral more with it. Flamfteed obferved a cloudy ftar in the bow of Sagittarius, containing many fmall ftars; and the ftar *d* above Sagittarius's right fhoulder is encompaffed with feveral more. Both Caffini and Flamfteed difcovered one between the Great and Little Dog, which is very full of ftars vifible only by the telefcope. The two whitifh fpots near the fouth pole, called the *Magellanic Clouds* by Sailors, which to the bare eye refemble part of the Milky Way, appear through telefcopes to be a mixture of fmall clouds and ftars. But the moft remarkable of all the cloudy ftars is that in the middle of Orion's Sword, where feven ftars (of which three are very clofe together) feem to fhine through a cloud, very lucid near the middle, but faint and ill defined about the edges. It looks like a gap in the fky, through which one may fee (as it were) part of a much brighter region. Although moft of thefe fpaces are but a few minutes of a degree in breadth, yet, fince they are among the fixed ftars, they muft be fpaces larger than what is occupied by our folar fyftem; and in which there feems to be a perpetual uninterrupted day among numberlefs worlds, which no human art ever can difcover.

Several ftars are mentioned by ancient aftronomers, which are not now to be found; and others are now vifible to the bare eye which are not recorded in the ancient catalogues. Hipparchus obferved a new ftar about 120 years before Chrift; but he has not mentioned in what part of the heaven it was feen, although it occafioned his making a catalogue of the ftars; which is the moft ancient that we have.

The firft new ftar that we have any good account of, was difcovered by Cornelius Gemma on the 8th of November *A. D.* 1572, in the chair of Caffiopea. It furpaffed Sirius in brightnefs and magnitude; and was feen for 16 months fucceffively. At firft it appeared bigger than Jupiter to fome eyes, by which it was feen at midday: afterwards it decayed gradually both in magnitude and luftre, until March 1573, when it became invifible.

On the 13th of Auguft 1596, David Fabricius obferved the Stella Mira, or wonderful ftar, in the neck of the Whale; which has been fince found to appear and difappear periodically, feven times in fix years, continuing in the greateft luftre for 15 days together; and is never quite extinguifhed.

In the year 1600, William Janfenius difcovered a changeable ftar in the neck of the Swan; which, in time, became fo fmall as to be thought to difappear entirely, till the years 1657, 1658, and 1659, when it recovered its former luftre and magnitude; but foon decayed, and is now of the fmalleft fize.

In the year 1604 Kepler and feveral of his friends faw a new ftar near the heel of the right foot of Serpentarius, fo bright and fparkling, that it exceeded any thing they had ever feen before; and took notice that it was every moment changing into fome of the colours of the rainbow, except when it was near the horizon, at which time it was generally white. It furpaffed Jupiter in magnitude, which was near it all the month of October, but eafily diftinguifhed from Jupiter, by the fteady light of Jupiter. It difappeared between October 1605 and the February following, and has not been feen fince that time.

In the year 1670, July 15, Hevelius difcovered a new ftar, which in October was fo decayed as to be fcarce perceptible. In April following it regained its luftre, but wholly difappeared in Auguft. In March 1672 it was feen again, but very fmall; and has not been vifible fince.

In the year 1686 a new ftar was difcovered by Kirch, which returns periodically in 404 days.

In the year 1672, Caffini faw a ftar in the neck of the Bull, which he thought was not vifible in Tycho's time, nor when Bayer made his figures.

Many ftars, befides thofe above mentioned, have been obferved to change their magnitudes: and as none of them could ever be perceived to have tails, it is plain they could not be comets; efpecially as they had no parallax, even when largeft and brighteft. It would feem, that the periodical ftars have vaft clufters of dark fpots, and very flow rotations on their axes; by which means, they muft difappear when the fide covered with fpots is turned towards us. And as for thofe which break out all of a fudden with fuch luftre, it is by no means improbable that they are funs whofe fuel is almoft fpent, and again fupplied by fome of their comets falling upon them, and occafioning an uncommon blaze and fplendor for fome time; which indeed appears to be the greateft ufe of the cometary part of any fyftem *.

Some

* *M. Maupertuis, in his differtation on the figures of the celeftial bodies, (p. 61,—63.), is of opinion that fome ftars, by their prodigious quick rotations on their axes, may not only affume the figures of oblate fpheroids, but that, by the great centrifugal force arifing from fuch rotations, they may become of the figures of mill-ftones;* or

Some of the ſtars, particularly Arcturus, have been obſerved to change their places above a minute of a degree with reſpect to others. But whether this be owing to any real motion in the ſtars themſelves, muſt require the obſervations of many ages to determine. If our ſolar ſyſtem changeth its place, with regard to abſolute ſpace, this muſt in proceſs of time occaſion an apparent change in the diſtances of the ſtars from each other: and in ſuch a caſe, the places of the neareſt ſtars to us being more affected than thoſe which are very remote, their relative poſitions muſt ſeem to alter, though the ſtars themſelves were really immoveable. On the other hand, if our own ſyſtem be at reſt, and any of the ſtars in real motion, this muſt vary their poſitions; and the more ſo, the nearer they are to us, or ſwifter their motions are, or the more proper the direction of their motion is for our perception.

The obliquity of the ecliptic to the equinoctial is found at preſent to be above the third part of a degree leſs than Ptolemy found it. And moſt of the obſervers after him found it to decreaſe gradually down to Tycho's time. If it be objected, that we cannot depend on the obſervations of the ancients, becauſe of the incorrectneſs of their inſtruments; we have to anſwer, that both Tycho and Flamſteed are allowed to have been very good obſervers; and yet we find that Flamſteed makes this obliquity $2\frac{1}{2}$ minutes of a degree leſs than Tycho did about 100 years before him: and as Ptolemy was 1324 years before Tycho, ſo the gradual decreaſe anſwers nearly to the difference of time between theſe three aſtronomers. If we conſider, that the earth is not a perfect ſphere, but an oblate ſpheriod, having its axis ſhorter than its equatorial diameter; and that the ſun and moon are conſtantly acting obliquely upon the greater quantity of matter about the equator, pulling it, as it were, towards a nearer and nearer co-incidence with the ecliptic; it will not appear improbable that theſe actions ſhould gradually diminiſh the angle between thoſe planes. Nor is it leſs probable that the mutual attractions of all the planets ſhould have a tendency to bring their orbits to a coincidence: but this change is too ſmall to become ſenſible in many ages.

CHAP. XVIII. *Of the Diviſion of Time. A perpetual Table of New Moons. The Times of the Birth and Death of* CHRIST. *A Table of remarkable Æras or Events.*

THE parts of time are *Seconds*, *Minutes*, *Hours*, *Days*, *Years*, *Cycles*, *Ages*, and *Periods*.

The original ſtandard, or integral meaſure of time, is a year; which is determined by the revolution of ſome celeſtial body in its orbit, *viz.* the ſun or moon.

The time meaſured by the ſun's revolution in the ecliptic, from any equinox or ſolſtice to the ſame again, is called the *Solar* or *Tropical Year*, which contains 365 days, 5 hours, 48 minutes, 57 ſeconds; and is the only proper or natural year, becauſe it always keeps the ſame ſeaſons to the ſame months.

The quantity of time meaſured by the ſun's revolution, as from any fixed ſtar to the ſame ſtar again, is called the *ſydereal year*; which contains 365 days 6 hours 9 minutes $14\frac{1}{2}$ ſeconds; and is 20 minutes $17\frac{1}{2}$ ſeconds longer than the true ſolar year.

The time meaſured by twelve revolutions of the moon, from the ſun to the ſun again, is called the *lunar year:* it contains 354 days 8 hours 48 minutes 36 ſeconds; and is therefore 10 days 21 hours 0 minutes 21 ſeconds ſhorter than the ſolar year. This is the foundation of the epact.

The *civil year* is that which is in common uſe among the different nations of the world; of which, ſome reckon by the lunar, but moſt by the ſolar. The civil ſolar year contains 365 days, for three years running, which are called *common years;* and then comes in what is called the *biſſextile* or *leap-year*, which contains 366 days. This is alſo called the *Julian year*, on account of Julius Cæſar, who appointed the intercalary-day every fourth year, thinking thereby to make the civil and ſolar year keep pace together. And this day, being added to the 23d of February, which in the Roman kalendar was the ſixth of the kalends of March, that ſixth day was twice reckoned, or the 23d and 24th were reckoned as one day, and was called *bis ſextus dies*; and thence came the name *biſſextile* for that year. But in our common almanacks this day is added at the end of February.

The *civil lunar year* is alſo common or intercalary. The common year conſiſts of 12 lunations, which contain 354 days; at the end of which, the year begins again. The *intercalary*, or *embolimic* year is that wherein a month was added, to adjuſt the lunar year to the ſolar. This method was uſed by the Jews, who kept their account by the lunar motions. But by intercalating no more than a month of 30 days, which they called *Ve-Adar*, every third year, they fell $3\frac{1}{4}$ days ſhort of the ſolar year in that time.

The Romans alſo uſed the *lunar embolimic year* at firſt, as it was ſettled by Romulus their firſt king, who made it to conſiſt only of ten months or lunations, which fell 61 days ſhort of the ſolar year, and ſo their year became quite vague and unfixed; for which reaſon, they were forced to have a table publiſhed by the high-prieſt, to inform them when the ſpring and other ſeaſons began.

or be reduced to flat circular planes, ſo thin as to be quite inviſible when their edges are turned towards us; as Saturn's ring is in ſuch poſitions. But when very excentric planets or comets go round any flat ſtar, in orbits much inclined to its equator, the attraction of the planets or comets in their perihelions muſt alter the inclination of the axis of that ſtar; on which account it will appear more or leſs large and luminous, as its broad ſide is more or leſs turned towards us. And thus he imagines we may account for the apparent changes of magnitude and luſtre in thoſe ſtars; and likewiſe for their appearing and diſappearing.

But Julius Cæſar, as already mentioned, taking this troubleſome affair into conſideration, reformed the kalendar, by making the year to conſiſt of 365 days 6 hours.

The year thus ſettled, is what we ſtill make uſe of in Britain; but as it is ſomewhat more than 11 minutes longer than the ſolar tropical year, the times of the equinoxes go backward, and fall earlier by one day in about 130 years. In the time of the Nicene Council, (*A. D.* 325), which was 1444 years ago, the vernal equinox fell on the 21ſt of March; and if we divide 1444 by 130. it will quote 11, which is the number of days which the equinox has fallen back ſince the Council of Nice. This cauſing great diſturbances, by unfixing the times of the celebration of Eaſter, and conſequently of all the other moveable feaſts, Pope Gregory XIIIth, in the year 1582, ordered ten days to be at once ſtruck out of that year; and the next day after the 4th of October was called the 15th. By this means the vernal equinox was reſtored to the 21ſt of March; and it was endeavoured, by the omiſſion of three intercalary days in 400 years, to make the civil or political year keep pace with the ſolar for time to come. This new form of the year is called the *Gregorian account*, or *new ſtyle*; which is received in all countries where the pope's authority is acknowledged, and ought to be in all places where truth is regarded.

The principal diviſion of the year is into *months*, which are of two ſorts, namely, *aſtronomical* and *civil*. The aſtronomical month is the time in which the moon runs through the zodiac, and is either *periodical* or *ſynodical*. The periodical month is the time ſpent by the moon in making one complete revolution from any point of the zodiac to the ſame again; which is $27^{d}\ 7^{h}\ 43^{m}$. The ſynodical month, called a *lunation*, is the time contained between the moon's parting with the ſun at a conjunction, and returning to him again, which is $29^{d}\ 12^{h}\ 44^{m}$. The civil months are thoſe which are framed for the uſes of civil life; and are different as to their names, number of days, and times of beginning, in ſeveral different countries. The firſt month of the Jewiſh year fell according to the moon in our Auguſt and September, old ſtyle; the ſecond in September and October; and ſo on. The firſt month of the Egyptian year began on the 29th of our Auguſt. The firſt month of the Arabic and Turkiſh year began the 16th of July. The firſt month of the Grecian year fell according to the moon in June and July, the ſecond in July and Auguſt, and ſo on, as in the following table.

A month is divided into four parts called *weeks*, and a week into ſeven parts called *days*; ſo that in a Julian year there are 13 ſuch months, or 52 weeks, and one day over. The Gentiles gave the names of the ſun, moon, and planets, to the days of the week. To the firſt, the name of the *Sun*; to the ſecond, of the *Moon*; to the third, of *Mars*; to the fourth, of *Mercury*; to the fifth, of *Jupiter*; to the ſixth, of *Venus*; and to the ſeventh, of *Saturn*.

N°	The Jewiſh year.		Days
1	Tiſri	Aug.—Sept.	30
2	Marcheſvan	Sept.—Oct.	29
3	Caſleu	Oct.—Nov	30
4	Tebeth	Nov.—Dec.	29
5	Shebat	Dec.—Jan.	30
6	Adar	Jan.—Feb.	29
7	Niſan *or* Abib	Feb.—Mar.	30
8	Jiar	Mar.—Apr.	29
9	Sivan	Apr.—May	30
10	Tamuz	May—June	29
11	Ab	June—July	30
12	Elul	July—Aug.	29
	Days in the year		354
	In the embolimic year after Adar they added a month called *Ve-Adar* of 30 days.		

N°	The Egyptian year.			Days
1	Thoth	Auguſt	29	30
2	Paophi	Septemb.	28	30
3	Athir	October	28	30
4	Chojac	Novemb.	27	30
5	Tybi	Decemb.	27	30
6	Mechir	January	26	30
7	Phamenoth	February	25	30
8	Parmuthi	March	27	30
9	Pachon	April	26	30
10	Payni	May	26	30
11	Epiphi	June	25	30
12	Meſori	July	25	30
	Epagomenæ or days added			5
	Days in the year			365

N°	The Arabic and Turkish year.			Days	N°	The ancient Grecian year.		Days
1	Muharram ——	July	16	30	1	Hecatombæon ——	June—July	30
2	Saphar ——	August	15	29	2	Metagitnion ——	July—Aug.	29
3	Rabia I. ——	Septemb.	13	30	3	Boedromion ——	Aug.—Sept.	30
4	Rabia II. ——	October	13	29	4	Pyanepsion ——	Sept.—Oct.	29
5	Jomada I. ——	Novemb.	11	30	5	Maimacterion ——	Oct.—Nov.	30
6	Jomada II. ——	Decemb.	11	29	6	Posideon ——	Nov.—Dec.	29
7	Rajab ——	January	9	30	7	Gamelion ——	Dec.—Jan.	30
8	Shasban ——	February	8	29	8	Anthesterion ——	Jan.—Feb.	29
9	Ramadam ——	March	9	30	9	Elaphebolion ——	Feb.—Mar.	30
10	Shawal ——	April	8	29	10	Munichion ——	Mar.—Apr.	29
11	Dulhaadah ——	May	7	30	11	Thargelion ——	Apr.—May	30
12	Dulheggia ——	June	5	29	12	Schirrophorion ——	May—June	29
	Days in the year ——			354		Days in the year ——		354
The Arabians add 11 days at the end of every year, which keep the same months to the same seasons.								

A *day* is either *natural* or *artificial*. The natural day contains 24 hours; the artificial the time from sun-rise to sun-set. The natural day is either *astronomical* or *civil*. The astronomical day begins at noon, because the increase and decrease of days terminated by the horizon are very unequal among themselves; which inequality is likewise augmented by the inconstancy of the horizontal refractions, and therefore the astronomer takes the meridian for the limit of diurnal revolutions, reckoning noon, that is, the instant when the sun's centre is on the meridian, for the beginning of the day. The British, French, Dutch, Germans, Spaniards, Portuguese, and Egyptians, begin the civil day at midnight; the ancient Greeks, Jews, Bohemians, Silesians, with the modern Italians, and Chinese, begin it at sun-setting; and the ancient Babylonians, Persians, Syrians, with the modern Greeks, at sun-rising.

An *hour* is a certain determinate part of the day, and is either *equal* or *unequal*. An equal hour is the 24th part of a mean natural day, as shewn by well-regulated clocks and watches; but these hours are not quite equal as measured by the returns of the sun to the meridian, because of the obliquity of the ecliptic and sun's unequal motion in it. Unequal hours are those by which the artificial day is divided into twelve parts, and the night into as many.

An hour is divided into 60 equal parts called *minutes*, a minute into 60 equal parts called *seconds*, and these again into 60 equal parts called *thirds*. The Jews, Chaldeans, and Arabians, divide the hour into 1080 equal parts called *scruples*; which number contains 18 times 60, so that one minute contains 18 scruples.

A *cycle* is a perpetual round, or circulation of the same parts of time of any sort. The *cycle of the sun* is a revolution of 28 years, in which time the days of the months return again to the same days of the week; the sun's place to the same signs and degrees of the ecliptic on the same months and days, so as not to differ one degree in 100 years; and the leap-years begin the same course over again with respect to the days of the week on which the days of the months fall. The *cycle of the moon*, commonly called the *golden number*, is a revolution of 19 years; in which time, the conjunctions, oppositions, and other aspects of the moon, are within an hour and half of being the same as they were on the same days of the months 19 years before. The *indiction* is a revolution of 15 years, used only by the Romans for indicating the times of certain payments made by the subjects to the republic: It was established by Constantine, A. D. 312.

The year of our Saviour's birth, according to the vulgar æra, was the 9th year of the solar cycle, the first year of the lunar cycle, and the 312th year after his birth was the first year of the Roman indiction. Therefore, to find the year of the solar cycle, add 9 to any given year of Christ, and divide the sum by 28, the quotient is the number of cycles elapsed since his birth, and the remainder is the cycle for the given year: If nothing remains, the cycle is 28. To find the lunar cycle, add 1 to the given year of Christ, and divide the sum by 19; the quotient is the number of cycles elapsed in the interval, and the remainder is the cycle for the given year: If nothing remains, the cycle is 19. Lastly, subtract 312 from the given year of Christ, and divide the remainder by 15; and what remains after this division is the indiction for the given year: If nothing remains, the indiction is 15.

Although the above deficiency in the lunar circle of an hour and an half every 19 years be but small, yet in time it becomes so sensible as to make a whole natural day in 310 years. So that, although this cycle be of use, when the golden numbers are rightly placed against the days of the months in the kalendar, as in our Common Prayer Books, for finding the days of the mean conjunctions or oppositions of the sun and moon, and consequently the time of Easter; it will only serve for 310 years, old style. For as the new and full moons anticipate a day in that time, the golden numbers ought

to

to be placed one day earlier in the kalendar for the next 310 years to come. Theſe numbers were rightly placed againſt the days of new moon in the kalendar, by the council of Nice, A. D. 325; but the anticipation, which has been neglected ever ſince, is now grown almoſt into 5 days: And therefore, all the golden numbers ought now to be placed 5 days higher in the kalendar for the old ſtyle than they were at the time of the ſaid council; or 6 days lower for the new ſtyle, becauſe at preſent it differs 11 days from the old.

Days.	*Jan.*	*Feb.*	*March*	*April*	*May*	*June*	*July*	*Aug.*	*Sep.*	*Oct.*	*Nov.*	*Dec.*
1	9		9	17	17	6				11		19
2		17			6	14	14	3	11		19	
3	17	6	17	6			3	11		19	8	8
4	6		6	14	14	3			19	8		16
5		14			3	11	11	19	8		16	
6	14	3	14	3			19			16	5	5
7	3		3	11	11	19		8	16			13
8		11			19	8	8	16	5	5	13	
9	11	19	11	19						13		2
10			19	8	8	16	16	5	13		2	10
11	19	8					5	13	2	2	10	
12	8	16	8	16	16	5				10		18
13					5	13	13	2	10		18	7
14	16	5	16	5			2	10	18	18	7	
15	5		5	13	13	2				7		15
16		13			2	10	10	18	7		15	
17	13	2	13	2			18	7		15	4	4
18	2		2	10	10	18			15			12
19		10			18	7	7	15	4	4	12	
20	10	18	10	18			15			12	1	1
21	18		18	7	7	15		4	12			9
22		7			15	4	4	12	1	1	9	
23	7	15	7	15			12			9	17	17
24			15	4	4	12		1	9			6
25	15	4			12		1	9	17	17	6	
26	4		4	12		1				6		15
27		12		1	1	9	9	17	6		14	
28	12	1	12		9		17	6	14	14	3	3
29	1		1	9		17				3		11
30					17	6	6	14	3		11	
31	9		9				14	3		11		19

In the above table the golden numbers under the months ſtand againſt the days of new moon in the left-hand column, for the new ſtyle; adapted chiefly to the ſecond year after leap-year, as being the neareſt mean for all the four; and will ſerve till the year 1960. Therefore, to find the day of new moon in any month of a given year till that time, look for the golden number of that year under the deſired month, and againſt it you have the day of new moon in the left-hand column. Thus, ſuppoſe it were required to find the day of new moon in September 1769; the golden number for that year is 3, which I look for under September, and right againſt it in the left-hand column you will find 30, which is the day of new moon in that month. *N. B.* If all the golden numbers, except 17 and 6, were ſet one day lower in the table, it would ſerve from the beginning of the year 1900 till the end of the year 2199. The table at the end of this chapter ſhews the golden number for 4000 years after the birth of Chriſt, by looking for the even hundreds of any given year at the left hand, and for the reſt to make up that year at the head of the table; and where the columns meet, you have the golden number (which is the ſame both in old and new ſtyle) for the given year. Thus, ſuppoſe the golden number was wanted for the year 1769; look for 1700 at the left hand of the table, and for 69 at the top of it; then guiding your eye downward from 69 to over-againſt 1700, you will find 3, which is the golden number for that year.

But becauſe the lunar cycle of 19 years ſometimes includes five leap-years, and at other times only four, this table will ſometimes vary a day from the truth in leap-years after February. And it is impoſſible to have one more correct, unleſs we extend it to four times 19 or 76 years; in which there are 19 leap-years without a remainder. But even then to have it of perpetual uſe, it muſt be adapted to the old ſtyle; becauſe, in every centurial year not diviſible by 4, the regular courſe of leap-years is interrupted in the new; as will be the caſe in the year 1800.

The cycle of Eaſter, alſo called the *Dionyſian period*, is a revolution of 532 years, found by multiplying the ſolar cycle 28 by the lunar cycle 19. If the new moons did not anticipate upon this cycle, Eaſter-day would always be the Sunday next after the firſt full moon, which follows the 21ſt of March. But, on account of the above anticipation, to which no proper regard was had before the late alteration of the ſtyle, the eccleſiaſtic Eaſter has ſeveral times been a week different from the true Eaſter within this laſt century: which inconvenience is now remedied by making the table, which uſed to find Eaſter for ever, in the Common Prayer Book, of no longer uſe than the lunar difference from the new ſtyle will admit of.

The earlieſt Eaſter poſſible is the 22d of March, the lateſt the 25th of April. Within theſe limits are 35 days, and the number belonging to each of them is called the *number of direction*; becauſe thereby the time of Eaſter is found for any given year.

The firſt ſeven letters of the alphabet are commonly placed in the annual almanacks, to ſhew on what days of the week the days of the months fall throughout the year. And becauſe one of thoſe ſeven letters muſt neceſſarily ſtand againſt Sunday, it is printed in a capital form, and called the *dominical letter:* The other ſix being inſerted in ſmall characters, to denote the other ſix days of the week. Now, ſince a common Julian year contains 365 days, if this number be divided by 7 (the

(the number of days in a week) there will remain one day. If there had been no remainder, it is plain the year would conſtantly begin on the ſame day of the week: but ſince one remains, it is plain, that the year muſt begin and end on the ſame day of the week; and therefore the next year will begin on the day following. Hence, when January begins on Sunday, *A* is the dominical or Sunday letter for that year: Then, becauſe the next year begins on Monday, the Sunday will fall on the ſeventh day, to which is annexed the ſeventh letter *G*, which therefore will be the dominical letter for all that year: and as the third year will begin on Tueſday, the Sunday will fall on the ſixth day; therefore *F* will be the Sunday letter for that year. Whence it is evident, that the Sunday letters will go annually in a retrograde order thus, *G*, *F*, *E*, *D*, *C*, *B*, *A*. And, in the courſe of ſeven years, if they were all common ones, the ſame days of the week and dominical letters would return to the ſame days of the months. But becauſe there are 366 days in a leap-year, if this number be divided by 7, there will remain two days over and above the 52 weeks of which the year conſiſts. And therefore, if the leap-year begins on Sunday, it will end on Monday; and the next year will begin on Tueſday, the firſt Sunday whereof muſt fall on the ſixth of January, to which is annexed the letter *F*, and not *G*, as in common years. By this means, the leap-year returning every fourth year, the order of the dominical letters is interrupted; and the ſeries cannot retnrn to its firſt ſtate till after four times ſeven, or 28 years; and then the ſame days of the months return in order to the ſame days of the week as before.

From the multiplication of the ſolar cycle of 28 years into the lunar cycle of 19 years, and the Roman indiction of 15 years, ariſes the great Julian period, conſiſting of 7980 years, which had its beginning 764 years before Strauchius's ſuppoſed year of the creation (for no later could all the three cycles begin together) and it is not yet compleated: And therefore it includes all other cycles, periods, and æras. There is but one year in the whole period that has the ſame nnmbers for the three cycles of which it is made up: And therefore, if hiſtorians had remarked in their writings the cycles of each year, there had been no diſpute about the time of any action recorded by them.

The Dionyſian or vulgar æra of Chriſt's birth was about the end of the year of the Julian period 4713; and conſequently the firſt year of his age, according to that account, was the 4714th year of the ſaid period. Therefore, if to the current year of Chriſt we add 4713, the ſum will be the year of the Julian period. So the year 1769 will be found to be the 6482d year of that period. Or, to find the year of the Julian period anſwering to any given year before the firſt year of Chriſt, ſubtract the number of that given year from 4714, and the remainder will be the year of the Julian period. Thus, the year 585 before the firſt year of Chriſt (which was the 584th before his birth) was the 4129th year of the ſaid period. Laſtly, to find the cycles of the ſun, moon, and indiction for any given year of this period, divide the given year by 28 19, and 15; the three remainders will be the cycles ſought, and the quotients the numbers of cycles run ſince the beginning of the period. So in the above 4714th year of the Julian period, the cycle of the ſun was 10, the cycle of the moon 2, and the cycle of indiction 4; the ſolar cycle having run through 168 courſes, the lunar 248, and the indiction 314.

The vulgar æra of Chriſt's birth was never ſettled till the year 527, when Dionyſius Exiguus, a Roman abbot, fixed it to the end of the 4713th year of the Julian period, which was four years too late. For our Saviour was born before the death of Herod, who ſought to kill him as ſoon as he heard of his birth. And, according to the teſtimony of Joſephus (*B*. xvii. *ch*. 8.) there was an eclipſe of the moon in the time of Herod's laſt illneſs; which eclipſe appears by our aſtronomical tables to have been in the year of the Julian period 4710, March 13th, at 3 hours paſt midnight, at Jeruſalem. Now, as our Saviour muſt have been born ſome months before Herod's death, ſince in the interval he was carried into Egypt, the lateſt time in which we can fix the true æra of his birth as about the end of the 4709th year of the Julian period.

As there are certain fixed points in the heavens from which aſtronomers begin their computations, ſo there are certain points of time from which hiſtorians begin to reckon; and theſe points or roots of time are called *æras* or *epochs*. The moſt remarkable æras are, thoſe of the Creation, the Greek Olympiads, the building of Rome, the æra of Nabonaſſar, the death of Alexander, the birth of Chriſt, the Arabian Hegira, and the Perſian Jeſdegird: All which, together with ſeveral others of leſs note, have their beginnings to the following table fixed to the years of the Julian period, to the age of the world at thoſe times, and to the years before and after the year of Chriſt's birth.

A Table of remarkable Æras and Events.

	Julian Period.	Yr. of the World.	Before Chriſt.
1. The creation of the world	706	0	4007
2. The deluge, or Noah's flood	2362	1656	2351
3. The Aſſyrian monarchy founded by Nimrod	2537	1831	2176
4. The birth of Abraham	2714	2008	1999
5. The deſtruction of Sodom and Gomorrah	2816	2110	1897
6. The beginning of the kingdom of Athens by Cecrops	3157	2451	155[illegible]
7. Moſes receives the ten commandments from God	3222	2516	149[illegible]
8. The entrance of the Iſraelites into Canaan	3262	2556	1[illegible]
9. The deſtruction of Troy	3529	2823	11[illegible]

10. The

	Julian Period.	Y. of the World.	Before Christ.
10. The beginning of king David's reign	3650	2944	1063
11. The foundation of Solomon's temple	3701	2995	1012
12. The Argonautic expedition	3776	3070	937
13. Lycurgus forms his excellent laws	3829	3103	884
14. Arbaces, the first king of the Medes	3838	3132	875
15. Mandaucus, the second	3865	3159	848
16. Sosarmus, the third	3915	3209	798
17. The beginning of the Olympiads	3938	3232	775
18. Artica, the fourth king of the Medes	3945	3239	768
19. The Catonian epocha of the building of Rome	3961	3255	752
20. The æra of Nabonassar	3967	3261	746
21. The destruction of Samaria by Salmaneser	3992	3286	721
22. The first eclipse of the moon on record	3993	3287	720
23. Cardicea, the fifth king of the Medes	3996	3290	717
24. Phraortes, the sixth	4058	3352	655
25. Cyaxares, the seventh	4080	3374	633
26. The first Babylonish captivity by Nebuchadnezzar	4107	3401	606
27. The long war ended between the Medes and Lydians	4111	3405	602
28. The second Babylonish captivity, and birth of Cyrus	4114	3408	599
29. The destruction of Solomon's temple	4125	3419	588
30. Nebuchadnezzar struck with madness	4144	3438	569
31. Daniel's vision of the four monarchies	4158	3452	555
32. Cyrus begins to reign in the Persian empire	4177	3471	536
33. The battle of Marathon	4223	3517	490
34. Artaxerxes Longimanus begins to reign	4249	3543	464
35. The beginning of Daniel's seventy weeks of years	4256	3350	457
36. The beginning of the Pelopennesian war	4282	3576	431
37. Alexander's victory at Arbela	4383	3677	330
38. The death of Alexander	4390	3684	323
39. The captivity of 100000 Jews by king Ptolemy	4393	3687	320
40. The Colossus of Rhodes thrown down by an earthquake	4491	3875	222
41. Antiochus defeated by Ptolemy Philopater	4496	3790	217
42. The famous Archimedes murdered at Syracuse	4506	3800	207
43. Jason butchers the inhabitants of Jerusalem	4543	3837	170
44. Corinth plundered and burnt by consul Mummius	4567	3861	146
45. Julius Cæsar invades Britain	4659	3953	54
46. He corrects the kalendar	4677	3961	46
47. Is killed in the Senate-house	4671	3965	42
48. Herod made king of Judea	4673	3967	40
49. Anthony defeated at the Battle of Actium	4683	3977	30
50. Agrippa builds the Pantheon at Rome	4688	3982	25
51. The true æra of Christ's birth	4709	4003	4
52. The death of Herod	4710	4004	3
			After Christ.
53. The Dionysian, or vulgar æra of Christ's birth	4713	4007	0
54. The true year of his crucifixion	4746	4040	33
55. The destruction of Jerusalem	4783	4077	70
56. Adrian builds the long wall in Britain	4833	4127	120
57. Constantius defeats the Picts in Britain	5019	4313	306
58. The council of Nice	5038	4332	325
59. The death of Constantine the great	5050	4344	337
60. The Saxons invited into Britain	5158	4452	445
61. The Arabian Hegira	5335	4629	622
62. The death of Mohammed the pretended prophet	5343	4637	630
63. The Persian Yesdegird	5344	4638	631
64. The sun, moon, and all the planets in Libra, Sep. 14. as seen from the earth	5899	5193	1186
65. The art of printing discovered	6153	5447	1440
66. The reformation begun by Martin Luther	6230	5524	1517

In

In fixing the year of the creation to the 706th year of the Julian period, which was the 4007th year before the year of Christ's birth, we have followed Mr Bedford in his scripture chronology, printed A. D. 1730, and Mr Kennedy in a work of the same kind, printed A. D. 1762.—Mr Bedford takes it only for granted that the world was created at the time of the autumnal equinox: But Mr Kennedy affirms, that the said equinox was at the noon of the fourth day of the creation-week, and that the moon was then 24 hours past her opposition to the sun.—If Moses had told us the same things, we should have had sufficient *data* for fixing the æra of the creation: But, as he has been silent on these points, we must consider the best accounts of chronologers as entirely hypothetical and uncertain.

TABLE, *shewing the Golden Number, (which is the same both in the Old and New Style), from the Christian Æra, to A. D.* 4000.

Hundreds of Years.			Years less than an hundred.																		
			0 19 38 57 76 95	1 20 39 58 77 96	2 21 40 59 78 97	3 22 41 60 79 98	4 23 42 61 80 99	5 24 43 62 81	6 25 44 63 82	7 26 45 64 83	8 27 46 65 84	9 28 47 66 85	10 29 48 67 86	11 30 49 68 87	12 31 50 69 88	13 32 51 70 89	14 33 52 71 90	15 34 53 72 91	16 35 54 73 92	17 36 55 74 93	18 37 56 75 94
0	1900	3800	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
100	2000	3900	6	7	8	9	10	11	12	13	14	15	16	17	18	19	1	2	3	4	5
200	2100	4000	11	12	13	14	15	16	17	18	19	1	2	3	4	5	6	7	8	9	10
300	2200	&c.	16	17	18	19	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
400	2300	—	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	1
500	2400	—	7	8	9	10	11	12	13	14	15	16	17	18	19	1	2	3	4	5	6
600	2500	—	12	13	14	15	16	17	18	19	1	2	3	4	5	6	7	8	9	10	11
700	2600	—	17	18	19	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
800	2700	—	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	1	2
900	2800	—	8	9	10	11	12	13	14	15	16	17	18	19	1	3	3	4	5	6	7
1000	2900	—	13	14	15	16	17	18	19	1	2	3	4	5	6	7	8	9	10	11	12
1100	3000	—	18	19	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1200	3100	—	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	1	2	3
1300	3200	—	9	10	11	12	13	14	15	16	17	18	19	1	2	3	4	5	6	7	8
1400	3300	—	14	15	16	17	18	19	1	2	3	4	5	6	7	8	9	10	11	12	13
1500	3400	—	19	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1600	3500	—	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	1	2	3	4
1700	3600	—	10	11	12	13	14	15	16	17	18	19	1	2	3	4	5	6	7	8	9
1800	3700	—	15	16	17	18	19	1	2	3	4	5	6	7	8	9	10	11	12	13	14

CHAP. XIX. *A Description of the Astronomical Machinery serving to explain and illustrate the foregoing part of this Treatise.*

THE ORRERY, (Plate XLVII. fig. 4.) This machine shews the motions of the sun, Mercury, Venus, earth, and moon; and occasionally the superior planets, Mars, Jupiter, and Saturn, may be put on; Jupiter's four satellites are moved round him in their proper times by a small winch; and Saturn has his five satellites, and his ring which keeps its parallelism round the sun; and by a lamp put in the sun's place, the ring shews all its various phases already described.

In the centre, No. 1. represents the sun, supported by its axis, inclining almost 8 degrees from the axis of the ecliptic, and turning round in $25\frac{1}{4}$ days on its axis, of which the north pole inclines toward the 8th degree of Pisces in the great ecliptic, (No. 11.), whereon the months and days are engraven over the signs and degrees in which the sun appears, as seen from the earth, on the different days of the year.

The nearest planet (No. 2.) to the sun is Mercury, which goes round him in 87 days 23 hours, or $87\frac{23}{24}$ diurnal rotations of the earth; but has no motion round its axis in the machine, because the time of its diurnal motion in the heavens is not known to us.

The next planet in order is Venus, (No. 3.), which performs her annual course in 224 days 17 hours, and turns round her axis in 24 days 8 hours, or in $24\frac{1}{3}$ diurnal rotations of the earth. Her axis inclines 75 degrees from the axis of the ecliptic, and her north pole inclines

towards the 20th degree of Aquarius, according to the obfervations of Bianchini. She fhews all the phenomena defcribed in Chap. I.

Next, without the orbit of Venus, is the Earth, (No. 4.), which turns round its axis, to any fixed point at a great diftance, in 23 hours 56 minutes 4 feconds, of mean folar time; but from the fun to the fun again, in 24 hours of the fame time. No. 6. is a fydereal dial-plate under the earth, and No. 7. a folar dial-plate on the cover of the machine. The index of the former fhews fydereal, and of the latter, folar time; and hence the former index gains one entire revolution on the latter every year, as 365 folar or natural days contain 366 fydereal days, or apparent revolutions of the ftars. In the time that the earth makes $365\frac{1}{4}$ diurnal rotations on its axis, it goes once round the fun in the plane of the ecliptic; and always keeps oppofite to a moving index (No. 10.) which fhews the fun's daily change of place, and alfo the days of the months.

The earth is half covered with a black cap, for dividing the apparently enlightened half next the fun from the other half, which, when turned away from him, is in the dark. The edge of the cap reprefents the circle bounding light and darknefs, and fhews at what time the fun rifes and fets to all places throughout the year. The earth's axis inclines $23\frac{1}{2}$ degrees from the axis of the ecliptic, the north pole inclines toward the beginning of Cancer, and keeps its parallelifm throughout its annual courfe; fo that in fummer the northern parts of the earth incline towards the fun, and in winter from him; by which means, the different lengths of days and nights, and the caufe of the various feafons, are demonftrated to fight.

There is a broad horizon, to the upper fide of which is fixed a meridian femicircle in the north and fouth points, graduated on both fides from the horizon to 90° in the zenith or vertical point. The edge of the horizon is graduated from the eaft and weft to the fouth and north points, and within thefe divifions are the points of the compafs. From the lower fide of this thin horizon-plate ftand out four fmall wires, to which is fixed a twilight-circle 18 degrees from the graduated fide of the horizon all round. This horizon may be put upon the earth, (when the cap is taken away), and rectified to the latitude of any place; and then, by a fmall wire called the *folar ray*, which may be put on fo as to proceed directly from the fun's centre towards the earth's, but to come no farther than almoft to touch the horizon. The beginning of twilight, time of fun-rifing, with his amplitude, meridian altitude, time of fetting, amplitude then, and end of twilight, are fhewn for every day of the year, at that place to which the horizon is rectified.

The Moon (No. 5.) goes round the earth, from between it and any fixed point at a great diftance, in 27 days 7 hours 43 minutes, or through all the figns and degrees of her orbit, which is called her *periodical revolution*; but fhe goes round from the fun to the fun again, or from change to change. in 29 days 12 hours 45 minutes, which is her *fynodical revolution*; and in that time fhe exhibits all the phafes already defcribed.

When the above mentioned horizon is rectified to the latitude of any given place, the times of the moon's rifing and fetting, together with her amplitude, are fhewn to that place as well as the fun's; and all the various phenomena of the harveft-moon are made obvious to fight.

The moon's orbit (No. 9.) is inclined to the ecliptic, (No. 11.), one half being above, and the other below it. The nodes, or points at o and o, lie in the plane of the ecliptic, as before defcribed, and fhift backward through all its fines and degrees in $18\frac{2}{3}$ years. The degrees of the moon's latitude to the higheft at *NL* (north latitude) and loweft at *SL*, (fouth latitude), are engraven both ways from her nodes at o and o; and as the moon rifes and falls in her orbit according to its inclination, her latitude and diftance from her nodes are fhewn for every day, having firft rectified her orbit fo as to fet the nodes to their proper places in the ecliptic; and then, as they come about at different, and almoft oppofite times of the year, and then point towards the fun, all the eclipfes may be fhewn for hundreds of years, (without any new rectification), by turning the machinery backward for time paft, or forward for time to come. At 17 degrees diftance from each node, on both fides, is engraved a fmall fun; and at 12 degrees diftance, a fmall moon; which fhew the limits of folar and lunar eclipfes: and when, at any change, the moon falls between either of thefe funs and the node, the fun will be eclipfed on the day pointed to by the annual index, (No. 10.); and as the moon has then north or fouth latitude, one may eafily judge whether that eclipfe will be vifible in the northern or fouthern hemifphere; efpecially as the earth's axis inclines toward the fun or from him at that time. And when, at any full, the moon falls between either of the little moons and node, fhe will be eclipfed, and the annual index fhews the day of that eclipfe. There is a circle of $29\frac{1}{2}$ equal parts (No. 8.) on the cover of the machine, on which an index fhews the days of the moon's age.

There are two femicircles (Plate XLVIII. fig. 1.) fixed to an elliptical ring, which being put like a cap upon the earth, and the forked part *F* upon the moon, fhews the tides as the earth turns round within them, and they are led round it by the moon. When the different places come to the femicircle *AaEbB*, they have tides of flood; and when they come to the femicircle *CED*, they have tides of ebb; the index on the hour-circle (No. 7. Plate XLVII.) fhewing the times of thefe phenomena.

There is a jointed wire, of which one end being put into a hole in the upright ftem that holds the earth's cap, and the wire laid into a fmall forked piece which may be occafionally put upon Venus or Mercury, fhews the direct and retrograde motions of thefe two planets, with their ftationary times and places, as feen from the earth.

The whole machinery is turned by a winch or handle, (No. 12.), and is fo eafily moved, that a clock might turn it without any danger of ftopping.

To give a plate of the wheel-work of this machine, would anfwer no purpofe, becaufe many of the wheels lie fo behind others as to hide them from fight in any view whatever.

The COMETARIUM, (Plate XLVIII. fig. 2.) This curious

Fig. 1.

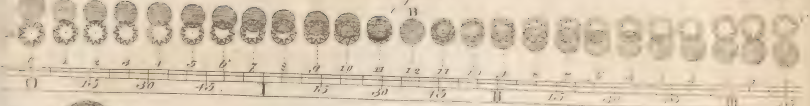


Fig. 2.

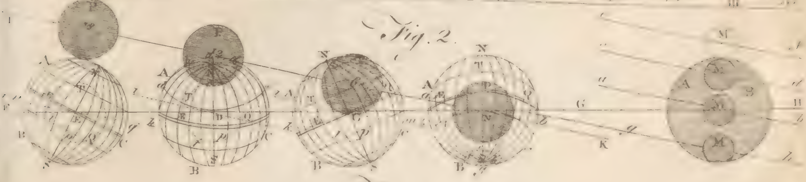
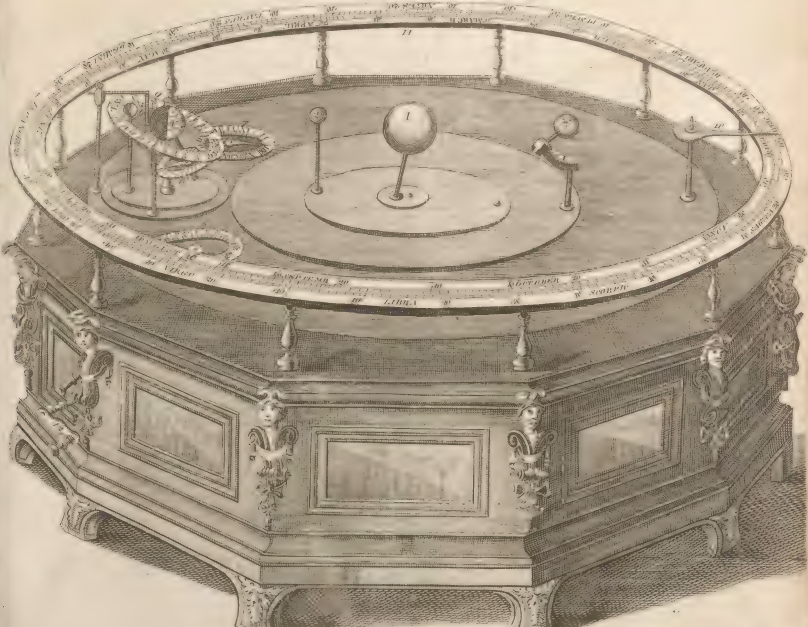


Fig. 3

FERGUSONS ORRERY



A. Bell Sculp.t

Fig. 1.

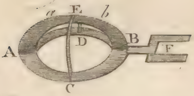


Fig. 2.

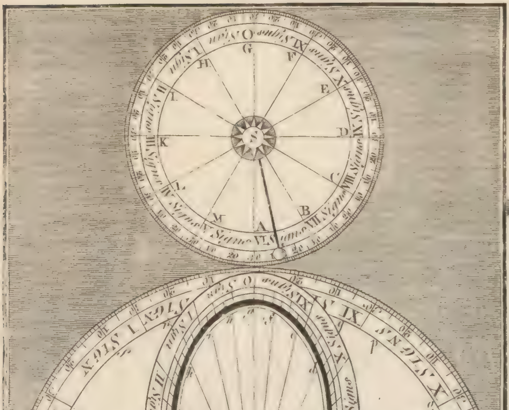
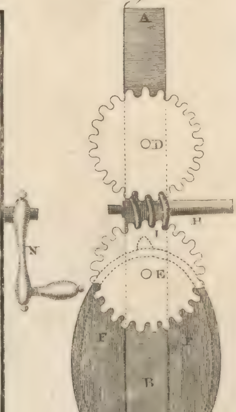


Fig. 3.



A Bell Sculp^t

curious machine shews the motion of a comet or excentric body moving round the sun, describing equal areas in equal times, and may be so contrived as to shew such a motion for any degree of excentricity. It was invented by the late Dr Desaguliers.

The dark elliptical groove round the letters *abcdefghiklm* is the orbit of the comet *Y*: this comet is carried round in the groove according to the order of letters, by the wire *W* fixed in the sun *S*, and slides on the wire as it approaches nearer to, or recedes farther from the sun, being nearest of all in the perihelion *a*, and farthest in the aphelion *g*. The areas, *aSb*, *bSc*, *cSd*, &c. or contents of these several triangles, are all equal; and in every turn of the winch *N*, the comet *Y* is carried over one of these areas; consequently, in as much time as it moves from *f* to *g*, or from *g* to *h*, it moves from *m* to *a*, or from *a* to *b*; and so of the rest, being quickest of all at *a*, and slowest at *g*. Thus the comet's velocity in its orbit continually decreases from the perihelion *a* to the aphelion *g*; and increases in the same proportion from *g* to *a*.

The elliptic orbit is divided into 12 equal parts or signs, with their respective degrees, and so is the circle *nopqrstu*, which represents a great circle in the heavens, and to which the comet's motion is referred by a small knob on the point of the wire *W*. Whilst the comet moves from *f* to *g* in its orbit, it appears to move only about five degrees in this circle, as is shewn by the small knob on the end of the wire *W*; but in as short time as the comet moves from *m* to *a*, or from *a* to *b*, and it appears to describe the large space *tn* or *no* in the heavens, either of which spaces contains 120 degrees, or four signs. Were the excentricity of its orbit greater, the greater still would be the difference of its motion, and *vice versa*.

ABCDEFGHIKLMA is a circular orbit for shewing the equable motion of a body round the sun *S*, describing equal areas *ASB*, *BSC*, &c. in equal times with those of the body *Y* in its elliptical orbit above mentioned; but with this difference, that the circular motion describes the equal arcs *AB*, *BC*, &c. in the same equal times that the elliptical motion describes the unequal arcs, *ab*, *bc*, &c.

Now, suppose the two bodies *Y* and 1 to start from the points *a* and *A* at the same moment of time, and, each having gone round its respective orbit, to arrive at these points again at the same instant, the body *Y* will be forwarder in its orbit than the body 1 all the way from *a* to *g*, and from *A* to *G*; but 1 will be forwarder than *Y* through all the other half of the orbit; and the difference is equal to the equation of the body *Y* in its orbit. At the points *aA*, and *gG*, that is, in the perihelion and aphelion, they will be equal; and then the equation vanishes. This shews why the equation of a body moving in an elliptic orbit, is added to the mean or supposed circular motion from the perihelion to the aphelion, and subtracted from the aphelion to the perihelion, in bodies moving round the sun, or from the perigee to the apogee, and from the apogee to the perigee in the moon's motion round the earth.

This motion is performed in the following manner by the machine, (Plate XLVIII. fig. 3.). *ABC* is a wooden bar, (in the box containing the wheel-work), above which are the wheels *D* and *E*, and below it the elliptic plates *FF* and *GG*; each plate being fixed on an axis in one of its focuses, at *E* and *K*; and the wheel *E* is fixed on the same axis with the plate *FF*. These plates have grooves round their edges precisely of equal diameters to one another, and in these grooves is the cat-gut string *gg*, *gg* crossing between the plates at *h*. On *H*, the axis of the handle or winch *N* in fig. 2. is an endless screw in fig. 3. working in the wheels *D* and *E*, whose numbers of teeth being equal, and should be equal to the number of lines *aS*, *bS*, *cS*, &c. in fig. 2. they turn round their axes in equal times to one another, and to the motion of the elliptic plates. For, the wheels *D* and *E* having equal numbers of teeth, the plate *FF* being fixed on the same axis with the wheel *E*, and the plate *FF* turning the equally big plate *GG* by a cat-gut string round them both, they must all go round their axes in as many turns of the handle *N* as either of the wheels has teeth.

It is easy to see, that the end *h* of the elliptical plate *FF* being farther from its axis *E* than the opposite end *I* is, must describe a circle so much the larger in proportion, and therefore move through so much more space in the same time; and for that reason the end *h* moves so much faster than the end *I*, although it goes no sooner round the centre *E*. But then the quick-moving end *h* of the plate *FF* leads about the short end *hK* of the plate *GG* with the same velocity; and the slow-moving end *I* of the plate *FF* coming half round as to *B*, must then lead the long end *k* of the plate *GG* as slowly about: so that the elliptical plate *FF* and its axis *E* move uniformly and equally quick in every part of its revolution; but the elliptical plate *GG*, together with its axis *K*, must move very unequally in different parts of its revolution; the difference being always inversely as the distance of any point of the circumference of *GG* from its axis at *K*: or in other words, to instance in two points, if the distance *Kk* be four, five, or six times as great as the distance *Kh*, the point *h* will move in that position four, five, or six times as fast as the point *k* does, when the plate *GG* has gone half round; and so on for any other excentricity or difference of the distances *Kk* and *Kh*. The tooth *I* on the plate *FF* falls in between the two teeth at *k* on the plate *GG*, by which means the revolution of the latter is so adjusted to that of the former, that they can never vary from one another.

On the top of the axis of the equally-moving wheel *D* in fig. 3. is the sun *S* in fig. 2.; which sun, by the wire fixed to it, carries the ball 1 round the circle *ABCD*, &c. with an equable motion, according to the order of the letters: and on the top of the axis *K* of the unequally-moving ellipsis *GG*, in fig. 3. is the sun *S* in fig. 2. carrying the ball *Y* unequably round in the elliptical groove *abcd*, &c. *N. B.* This elliptical groove must be precisely equal and similar to the verge of the plate *GG*, which is also equal to that of *FF*.

In this manner machines may be made to shew the true

true motion of the moon about the earth, or of any planet about the fun, by making the elliptical plates of the fame excentricities, in proportion to the radius, as the orbits of the planets are, whofe motions they reprefent; and fo their different equations in different parts of their orbits may be made plain to fight, and clearer ideas of thefe motions and equations acquired in half an hour, than could be gained from reading half a day about fuch motions and equations.

The IMPROVED CELESTIAL GLOBE, (Plate XLIV. fig. 2.). On the north pole of the axis, above the hour-circle, is fixed an arch *MKH* of $23\frac{1}{2}$ degrees; and at the end *H* is fixed an upright pin *HG*, which ftands directly over the north pole of the ecliptic, and perpendicular to that part of the furface of the globe. On this pin are two moveable collets at *D* and *H*, to which are fixed the quadrantile wires *N* and *O*, having two little balls on their ends for the fun and moon, as in the figure. The collet *D* is fixed to the circular plate *F*, whereon the $29\frac{1}{2}$ days of the moon's age are engraven, beginning juft under the fun's wire *N*; and as this wire is moved round the globe, the plate *F* turns round with it. Thefe wires are eafily turned, if the fcrew *G* be flackened; and when they are fet to their proper places, the fcrew ferves to fix them there fo as in turning the ball of the globe, the wires with the fun and moon go round with it; and thefe two little balls rife and fet at the fame times, and on the fame points of the horizon, for the day to which they are rectified, as the fun and moon do in the heavens.

Becaufe the moon keeps not her courfe in the ecliptic, (as the fun appears to do), but has a declination of $5\frac{1}{3}$ degrees on each fide from it in every lunation, her ball may be fcrewed as many degrees to either fide of the ecliptic as her latitude or declination from the ecliptic amounts to at any given time; and for this purpofe *S*, Plate LI. fig. 2. *(by miftake omitted to be inferted in the proper plate)* is a fmall piece of pafteboard, of which the curved edge at *S* is to be fet upon the globe at right angles to the ecliptic, and the dark line over *S* to ftand upright upon it. From this line, on the convex edge, are drawn the $5\frac{1}{3}$ degrees of the moon's latitude on both fides of the ecliptic; and when this piece is fet upright on the globe, its graduated edge reaches to the moon on the wire *O*, by which means fhe is eafily adjufted to her latitude found by an ephemeris.

The horizon is fupported by two femicircular arches, becaufe pillars would ftop the progrefs of the balls when they go below the horizon in an oblique fphere.

To rectify this globe. Elevate the pole to the latitude of the place; then bring the fun's place in the ecliptic for the given day to the brafen meridian, and fet the hour-index to XII at noon, that is to the upper XII on the hour-circle; keeping the globe in that fituation, flacken the fcrew *G*, and fet the fun directly over his place on the meridian; which done, fet the moon's wire under the number that expreffes her age for that day on the plate *F*; and fhe will then ftand over her place in the ecliptic, and fhew what conftellation fhe is in. Laftly, faften the fcrew *G*, and laying the curved edge of the pafteboard *S* over the ecliptic below the moon, adjuft the moon to her latitude over the graduated edge of the pafteboard; and the globe will be rectified.

Having thus rectified the globe, turn it round, and obferve on what points of the horizon the fun and moon balls rife and fet, for thefe agree with the points of the compafs on which the fun and moon rife and fet in the heavens on the given day; and the hour-index fhews the times of their rifing and fetting; and likewife the time of the moon's paffing over the meridian.

This fimple apparatus fhews all the varieties that can happen in the rifing and fetting of the fun and moon; and makes the fore-mentioned phenomena of the harveft-moon plain to the eye. It is alfo very ufeful in reading lectures on the globes, becaufe a large company can fee this fun and moon go round, rifing above and fetting below the horizon at different times, according to the feafons of the year; and making their appulfes to different fixed ftars. But in the ufual way, where there is only the places of the fun and moon in the ecliptic to keep the eye upon, they are eafily loft fight of, unlefs they be covered with patches.

The PLANETARY GLOBE, (Plate XLIX. fig. 1.) In this machine, a terreftrial globe is fixed on its axis ftanding upright on the pedeftal *C D E*, on which is an hour-circle, having its index fixed on the axis, which turns fomewhat tightly in the pedeftal, fo that the globe may not be liable to fhake; to prevent which, the pedeftal is about two inches thick, and the axis goes quite through it, bearing on a fhoulder. The globe is hung in a graduated brazen meridian, much in the ufual way; and the thin plate *N*, *NE*, *E* is a moveable horizon graduated round the outer edge, for fhewing the bearings and amplitudes of the fun, moon, and planets. The brafen meridian is grooved round the outer edge; and in this groove is a flender femi-circle of brafs, the ends of which are fixed to the the horizon in its north and fouth points: this femi-circle flides in the groove as the horizon is moved in rectifying it for different latitudes. To the middle of this femi-circle is fixed a pin, which always keeps in the zenith of the horizon, and on this pin the quadrant of altitude *q* turns; the lower end of which, in all pofitions, touches the horizon as it is moved round the fame. This quadrant is divided into 90 degrees from the horizon to the zenithal pin on which it is turned, at 90. The great flat circle or plate *AB* is the ecliptic, on the outer edge of which the figns and degrees are laid down; and every fifth degree is drawn through the reft of the furface of this plate towards its center. On this plate are feven grooves, to which feven little balls are adjufted by fliding wires, fo that they are eafily moved in the grooves, without danger of ftarting them. The ball next the terreftrial globe is the moon, the next without it is Mercury, the next Venus, the next the fun, then Mars, then Jupiter, and laftly Saturn. This plate, or ecliptic, is fupported by four ftrong wires, having their lower ends fixed into the pedeftal, at *C*, *D*, *E*, the fourth being hid by the globe. The ecliptic is inclined $23\frac{1}{2}$ degrees to the pedeftal, and is therefore properly inclined to the axis of the globe which ftands upright on the pedeftal.

To rectify this machine. Set the fun, and all the planetary balls, to their geocentric places in the ecliptic for any given time, by an ephemeris; then fet the north point of the

the horizon to the latitude of your place on the brasen meridian, and the quadrant of altitude to the south point of the horizon; which done, turn the globe with its furniture till the quadrant of altitude comes right against the sun, viz. to his place in the ecliptic; and keeping it there, set the hour-index to the XII next the letter C; and the machine will be rectified, not only for the following problems, but for several others which the artist may easily find out.

Problem I. *To find the amplitudes, meridian altitudes, and times of rising, culminating, and setting, of the sun, moon, and planets.*

Turn the globe round eastward, or according to the order of signs; and as the eastern edge of the horizon comes right against the sun, moon, or any planet, the hour-index will shew the time of its rising; and the inner edge of the ecliptic will cut its rising amplitude in the horizon. Turn on, and as the quadrant of altitude comes right against the sun, moon or planets, the ecliptic cuts their meridian altitudes in the quadrant, and the hour-index shews the times of their coming to the meridian. Continue turning, and as the western edge of the horizon comes right against the sun, moon, or planets, their setting amplitudes are cut in the horizon by the ecliptic; and the times of their setting are shewn by the index on the hour-circle.

Prob. II. *To find the altitude and azimuth of the sun, moon, and planets, at any time of their being above the horizon.*

Turn the globe till the index comes to the given time in the hour-circle, then keep the globe steady, and moving the quadrant of altitude to each planet respectively, the edge of the ecliptic will cut the planet's mean altitude on the quadrant, and the quadrant will cut the planet's azimuth, or point of bearing on the horizon.

Prob. III. *The sun's altitude being given at any time either before or after noon, to find the hour of the day, and variation of the compass, in any known latitude.*

With one hand hold the edge of the quadrant right against the sun; and, with the other hand, turn the globe westward, if it be in the forenoon, or eastward if it be in the afternoon, until the sun's place at the inner edge of the ecliptic cuts the quadrant in the sun's observed altitude; and then the hour-index will point out the time of the day, and the quadrant will cut the true azimuth, or bearing of the sun for that time: The difference between which, and the bearing shewn by the azimuth compass, shews the variation of the compass in that place of the earth.

The Trajectorium Lunare, Plate XLIX. fig. 2. This machine is for delineating the paths of the earth and moon, shewing what sort of curves they make in the etherial regions. S is the sun, and E the earth, whose centres are 81 inches distant from each other; every inch answering to a million of miles. M is the moon, whose centre is $\frac{24}{100}$ parts of an inch from the earth's in this machine, this being in just proportion to the moon's distance from the earth. AA is a bar of wood, to be moved by hand round the axis g which is fixed in the wheel Y. The circumference of this wheel is to the circumference of the small wheel L (below the other end of the bar) as $365\frac{1}{4}$ days is to $29\frac{1}{2}$, or as a year is to a lunation. The wheels are grooved round their edges, and in the grooves is the cat-gut string GG crossing between the wheels at X. On the axis of the wheel L is the index F, in which is fixed the moon's axis M for carrying her round the earth E (fixed on the axis of the wheel L) in the time that the index goes round a circle of $29\frac{1}{2}$ equal parts, which are the days of the moon's age. The wheel Y has the months and days of the year all round its limb; and in the bar AA is fixed the index I, which points out the days of the months answering to the days of the moon's age, shewn by the index F, in the circle of $29\frac{1}{2}$ equal parts at the other end of the bar. On the axis of the wheel L is put the piece D, below the cock C, in which this axis turns round; and in D are put the pencils e and m, directly under the earth E and moon M; so that m is carried round e, as M is round E.

Lay the machine on an even floor, pressing gently on the wheel Y, to cause its spiked feet (of which two appear at P and P, the third being supposed to be hid from sight by the wheel) enter a little into the floor to secure the wheel from turning. Then lay a paper about four feet long under the pencils e and m, cross-wise to the bar; which done, move the bar slowly round the axis g of the wheel Y; and as the earth E goes round the sun S, the moon M will go round the earth with a duly proportioned velocity; and the friction-wheel W running on the floor, will keep the bar from bearing too heavily on the pencils e and m, which will delineate the paths of the earth and moon. As the index I points out the days of the months, the index F shews the moon's age on these days, in the circle of $29\frac{1}{2}$ equal parts. And as this last index points to the different days in its circle, the like numeral figures may be set to those parts of the curves of the earth's path and moon's, where the pencils e and m are at those times respectively, to shew the places of the earth and moon. If the pencil e be pushed a very little off, as if from the pencil m, to about $\frac{1}{40}$ part of their distance, and the pencil m pushed as much towards e, to bring them to the same distances again, though not to the same points of space; then, as m goes round e, e will go as it were round the centre of gravity between the earth e and moon m; but this motion will not sensibly alter the figure of the earth's path or the moon's.

If a pin, as p, be put through the pencil m, with its head towards that of the pin q in the pencil e, its head will always keep thereto as m goes round e, or as the same side of the moon is still obverted to the earth. But the pin p, which may be considered as an equatorial diameter of the moon, will turn quite round the point m, making all possible angles with the line of its progress, o line of the moon's path. This is an ocular proof of the moon's turning round her axis.

The

The Tide-Dial, Plate L. fig. 1. The outside parts of this machine consist of, 1. An eight-sided box, on the top of whichat the corners is shewn the phases of the moon at the octants, quarters, and full. Within these is a circle of $29\frac{1}{2}$ equal parts, which are the d ys of the moon's age accounted from the sun at new moon, round to the sun again. Within this circle is one of 24 hours divided into their respective halves and quarters. 2. A moving elliptical plate, painted blue, to represent the rising of the tides under and opposite to the moon; and has the words, *high water, tide falling, low water, tide rising*, marked upon it. To one end of this plate is fixed the moon *M* by the wire *W*, and goes along with it. 3. Above this elliptical plate is a round one, with the points of the compass upon it, and also the names of above 200 places in the large machine (but only 32 in the figure, to avoid confusion) set over those points in which the moon bears when she raises the tides to the greatest heights at these places twice in every lunar day: And to the north and south points of this plate are fixed two indexes *I* and *K*, which shew the times of high water, in the hour circle, at all these places. 4. Below the elliptical plate are four small plates, two of which project out from below its ends at new and full moon; and so, by lengthening the ellipse, shew the spring-tides, which are then raised to the greatest heights by the united attractions of the sun and moon. The other two of these small plates appear at low water when the moon is in her quadratures, or at the sides of the elliptic plate, to shew the neap-tides; the sun and moon then acting cross-wise to each other. When any two of these small plates appear, the other two are hid; and when the moon is in her octants, they all disappear, their being neither spring nor neap-tides at those times. Within the box are a few wheels for performing these motions by the handle or winch *H*.

Turn the handle until the moon *M* comes to any given day of her age in the circle of $29\frac{1}{2}$ equal parts, and the moon's wire *W* will cut the time of her coming to the meridian on that day, in the hour circle; the XII under the sun being mid-day, and the opposite XII midnight: Then looking for the name of any given place on the round plate (which makes $29\frac{1}{2}$ rotations whilst the moon *M* makes only one revolution from the sun to the sun again) turn the handle till that place comes to the word *high water* under the moon, and the index which falls among the forenoon hours will shew the time of high water at that place in the forenoon of the given day: then turn the plate half round, till the same place comes to the opposite high-water mark, and the index will shew the time of high water in the afternoon at that place. And thus, as all the different places come successively under and opposite to the moon, the indexes shew the times of high water at them in both parts of the day: And, when the same places come to the low-water marks, the indexes shew the times of low water. For about three days before and after the times of new and full moon, the two small plates come out a little way from below the high-water marks on the elliptical plate, to shew that the tides rise still higher about these times: And about the quarters, the other two plates come out a little from under the low-water marks towards the sun, and on the opposite side, shewing that the tides of flood rise not then so high, nor do the tides of ebb fall so low, as at other times.

By pulling the handle a little way outward, it is disengaged from the wheel-work, and then the upper plate may be turned round quickly by hand, so as the moon may be brought to any given day of her age in about a quarter of a minute; and by pushing in the handle, it takes hold of the wheel-work again.

On *AB*, (fig. 2) the axis of the handle *H*, is an endless screw *C*, which turns the wheel *FED* of 24 teeth round in 24 revolutions of the handle: This wheel turns another *ONG* of 48 teeth, and on its axis is the pinion *PQ* of four leaves, which turns the wheel *LKI* of 59 teeth round in $29\frac{1}{2}$ turnings or rotations of the wheel *FED*, or in 708 revolutions of the handle, which is the number of hours in a synodical revolution of the moon. The round plate, with the names of places upon it, is fixed on the axis of the wheel *FED*; and the elliptical or tide-plate with the moon fixed to it, is upon the axis of the wheel *LKI*; consequently, the former makes $29\frac{1}{2}$ revolutions in the time that the latter makes one. The whole wheel *FED*, with the endless screw *C*, and dotted part of the axis of the handle *AB*, together with the dotted part of the wheel *ONG*, lie hid below the large wheel *LKI*.

ASTROP-WELLS, in Northamptonshire, were recommended by the physicians Willis and Clever, for the cure of the scurvy, asthma, &c.

ASTROSCOPE, an instrument composed of two canes, having the constellations delineated on their surfaces, whereby the stars may be easily known.

ASTRUM, with chemists, signifies that virtue which accrues to things from their preparation; and among ancient physicians, certain medicines in the figure of round cakes impressed with asterisks.

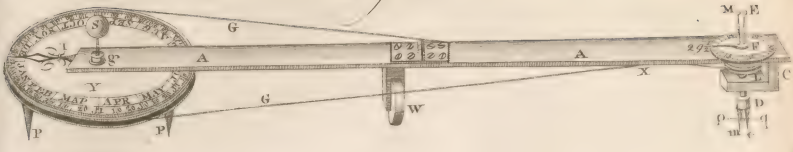
ASTUR, in ornithology, a synonime of a species of falco. See Falco.

ASTURIA, a maritime province of Spain, lying along the bay of Biscay, with Gallicia on the west, and Biscay on the east. It gives the title of prince to the eldest son of the king of Spain.

ASTYNOMI, in Grecian antiquity, magistrates in Athens, corresponding to the ædiles of the Romans; they were ten in number. See Ædile.

ASYLUM, a sanctuary, or place of refuge, where criminals shelter themselves from the hands of justice. The asyla of altars and temples were very ancient; and likewise those of tombs, statues, and other monuments of considerable personages: Thus, the temple of Diana at Ephesus was a refuge for debtors, the tomb of Theseus for slaves. The Jews had their asyla

Fig. 2.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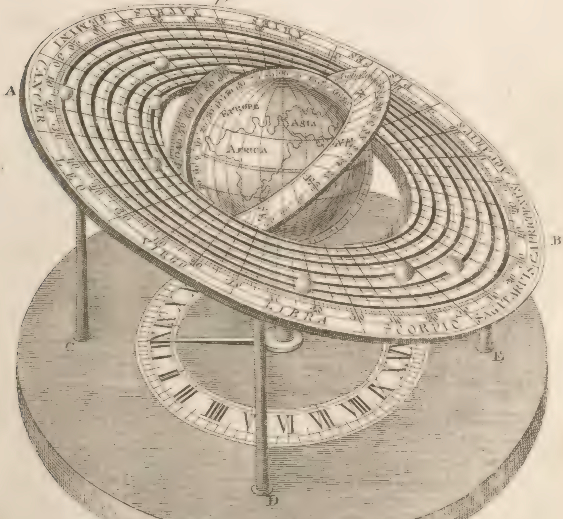
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Fig. 2.

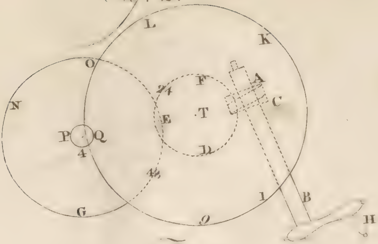
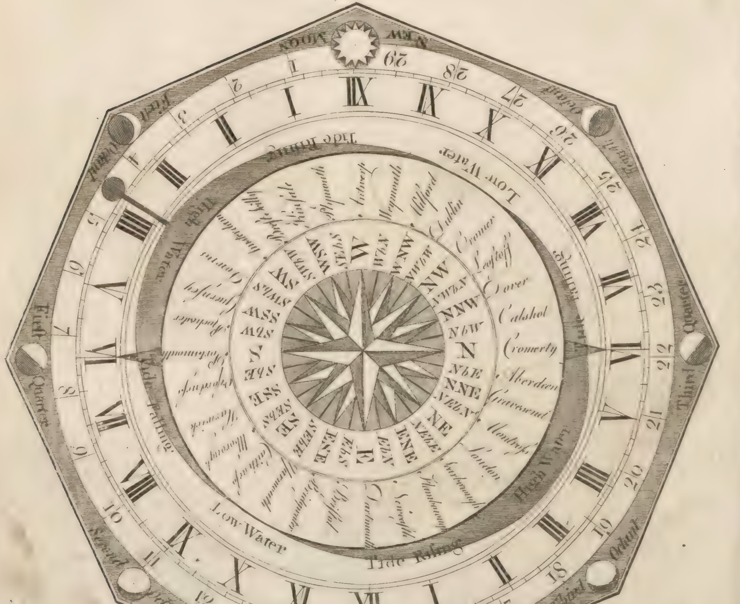


Fig. 1.



J. Bell sculp.

asyla, the most remarkable of which were, the six cities of refuge, the temple, and the altar of burnt-offerings.

ASYMMETRY, the want of proportion between the parts of any thing, being the contrary of symmetry. See SYMMETRY.

ASYMPTOTE, in geometry, a line which continually approaches nearer to another; but, though continued infinitely, will never meet with it: Of these there are many kinds. In strickness, however, the term *asymptotes* is appropriated to right lines, which approach nearer and nearer to some curves of which they are said to be *asymptotes*; but if they and their curve are indefinitely continued, they will never meet.

ASYMPTOTIC *space*, the same with hyperbolic space. See HYPERBOLIC.

ASYNDETON, in grammar, a figure which omits the conjunctions in a sentence; as in *veni, vidi, vici*, ET is left out.

ATARAXY, a term used by the stoics and sceptics, to denote that calmness of mind which secures us from all emotions arising from vanity and self-conceit.

ATAXY, in a general sense, the want of order: With physicians, it signifies irregularity of crises and paroxysms of fevers.

ATCHE, in commerce, a small silver coin used in Turky, and worth only one third of the English penny.

ATCHIEVEMENT, in heraldry, denotes the arms of a person, or family, together with all the exterior ornaments of the shield; as helmet, mantle, crest, scrolls, and motto, together with such quarterings as may have been acquired by alliances, all marshalled in order.

A TEMPO GIUSTO, in music, signifies to sing and or play in an equal, true, and just time. See TIME.

ATHAMADULET, the prime minister of the Persian empire, as the grand vizier is of the Turkish empire. He is great chancellor of the kingdom, president of the council, superintendant of the finances, and is charged with all foreign affairs.

ATHAMANTA, in botany, a genus of the pentandria digynia class. The fruit is oblong and streaked. The species are 10, only one of which, *viz.* the libanotis or mountain stone-parsley is a native of Britain. The root of the athamanta meum or spignel, a native of Italy, is an useful aromatic and carminative, though little regarded in the present practice.

ATHANASIA, in botany, a genus of the syngenesia polygamia æqualis class. There are ten species of this genus, most of them natives of Africa.

ATHANASIAN *creed*, that supposed to be composed by Athanasius. See CREED.

ATHANATI, in Persian antiquity, a body of cavalry, consisting of ten thousand men, always complete. They were called *athanati*, because, when one of them happened to die, another was immediately appointed to succeed him.

ATHANOR, in chemistry, a kind of fixed and large digesting furnace, made with a tower, so contrived as to keep a constant moderate heat for a considerable time, which may be increased or diminished at pleasure by shutting the registers. See CHEMISTRY, *Of furnaces*.

ATHEIST, a person who does not believe the existence of a Deity. Many people, both ancient and modern, have pretended to atheism, or have been reckoned atheists by the world; but it is justly questioned whether any man seriously adopted such a principle. These pretensions, therefore, must be founded on pride or affectation.

ATHELING, ADELING, EDLING, ETHLING, or ETHELING, among our Saxon ancestors, was a title of honour properly belonging to the heir apparent, or presumptive, to the crown. This honourable appellation was first conferred by king Edward the Confessor on Edgar, to whom he was great uncle, when, being without any issue of his own, he intended to make him his heir.

ATHENA, a plaster made of aloes, myrrh, and gum ammoniac, and recommended by some ancient physicians in wounds of the head.

ATHENÆA, in Grecian antiquity. See PANATHENÆA.

ATHENÆUM, in antiquity, a public place wherein the professors of the liberal arts held their assemblies, the rhetoricians declaimed, and the poets rehearsed their performances.

These places, of which there were a great number at Athens, were built in the manner of amphitheatres, encompassed with seats, called *cunei*. The three most celebrated Athenæa were those at Athens, at Rome, and at Lyons, the second of which was built by the emperor Adrian.

ATHENREE, a town of Ireland, in the county of Galway, and province of Connaught, situated about ten miles eastward of the city of Galway, in 8° 50′ W. long. and 53° 14′ N. lat.

ATHENS, anciently the capital of Attica, so famous for its learned men, orators, and captains, now called *Setines*. It stands upon a plain watered by the rivers Illissus and Eridanus, about 40 miles east of the isthmus of Corinth: At present it is said to contain 10,000 inhabitants, three parts of which are Christians. The town does not lie round the castle as anciently, but on the north-west side of it. Here a Greek metropolitan resides. Among the many remains of antiquity, is the temple of Jupiter Olympius, and temple of Minerva, called *Parthenion*, which last is still entire, and converted into a Turkish mosque, which, as later travellers assure us, is the finest temple in the world. This city, as all the rest of Greece, is subject to the Turks. E. long. 24° 15′ N. lat. 38° 5′

ATHERINA, in ichthyology, a genus of fishes of the order of abdominales. The characters of this genus are these: The upper jaw is plain; the rays of the branchiostege membrane are six; and the side-belt or line shines like silver. The species are two, *viz.* 1. The hepsetus, with about 12 rays in the fin next the anus. It is found in the Mediterranean. 2. The menidea, with 24 rays in the fin next the anus. This is a very small pellucid fish, with many black points interspersed;

terfperfed; it has many teeth in the lips, but none in the tongue or jaws. It is found in the frefh waters or Carolina, and fpawns in April.

ATHEROMA, in medicine, a tumour without pain or difcolouring of the fkin, containing, in a membranaceous bag, matter like pus, intermixed with hard and ftony corpufcles, *&c.*

ATHERTON, a town of Warwickfhire, fituated about ten miles north of Coventry, in 1° 30′ W. long. and 52° 40′ N. lat.

ATHLETÆ, in antiquity, men of remarkable ftrength and agility, difciplined to perform in the public games. This was a general term, under which were comprehended wreftlers, boxers, runners, leapers, throwers of the difc, and thofe who practifed in other exercifes exhibited in the Olympic, Pythian, and other folemn fports, wherein there were prizes allotted for the conquerors.

ATHLONE, a ftrong town in the county of Weftmeath, in the province of Connaught in Ireland, fituated on the river Shannon, about 60 miles weft of Dublin, in 8° 5′ W. long. and 53° 20′ N. lat.

ATHOL, a diftrict of Perthfhire in Scotland, from whence the ancient and noble family of Murray takes the title of duke.

ATHOS, a celebrated mountain, fituated in the province of Macedonia, on a peninfula, which ftretches into the Ægean fea, near the gulf of Conteffa, being an entire chain of mountains extended near feven miles in length, and three in breadth. It is now called Monte Santo, from the 22 monafteries, befides cells and caves, upon it, containing near 6000 monks and hermits; no woman is allowed to come within fight of their convents. It is fituated 70 miles eaft of Salonichi, or Theffalonica, and pays confiderable tribute to the Turks, it being under the protection of the boftangi bafcha; on this chain formerly ftood five cities. N. Lat. 40° 10′ E. long. 26° 20′.

ATHY, a town of Ireland, in the county of Kildare and province of Leinfter, fituated on the river Barrow, about 10 miles fouth of Kildare, in 7° 5′ W. long. and 53° N. lat.

ATIGNY, a fmall town of Champaign in France, fituated on the river Aifne, about 20 miles fouth of Rheims, in 4° 40′ E. long. and 49° 25′ N. lat.

ATINGUACU, in ornithology. See CUCULUS.

ATLANTIC OCEAN, that bounded by Europe and Africa on the eaft, and by America on the weft.

ATLANTIDES, in aftronomy. See PLEIADES.

ATLAS the name of a ridge of mountains, running from eaft to weft through the north of Africa, from whence the Atlantic Ocean took its name.

ATLAS, in architecture, the fame with telamon. See TELAMON.

ATLAS, in anatomy, the name by which fome call the firft vertebra of the neck; fo called in allufion to Mount Atlas. See p. 167.

ATLAS, in matters of literature, denotes a book of univerfal geography, containing maps of all the known parts of the world.

ATMOSPHERE, the vaft collection of air which furrounds the earth for a great height. For the height and other properties of the atmofphere, fee PNEUMATICS.

ATOM, in philofophy, a particle of matter, fo minute as to admit of no divifion. Atoms are the *minima naturæ*, and are conceived as the firft principles or component parts of all phyfical magnitude. See CHEMISTRY.

ATOMICAL *philofophy*, or the doctrine of atoms, a fyftem which, from the hypothefis that atoms are endued with gravity and motion, accounted for the origin and formation of things. This philofophy was firft broached by Mofchus, fome time before the Trojan war; but was much cultivated and improved by Epicurus, whence it is denominated the Epicurean philofophy. See EPICUREAN.

ATONICS, in grammar, words not accented. See ACCENT.

ATONY, in medicine, a defect of tone or tenfion, or a laxity or debility of the folids of the body.

ATRA BILIS, black bile, one of the humours of the ancient phyficians; which the moderns call melancholy.

ATRACTYLIS, in botany, a genus of the fyngenefia polygamia æqualis clafs. The corolla is radiated, and each corolla of the radius has five teeth. The fpecies are three, none of which are natives of Britain.

ATRAGENE, in botany, a genus of the polyandria polygynia clafs. The calix has four leaves: the petals are 12; and the feeds are caudated. There are three fpecies, all natives of the eaft.

ATRAPHAXIS, in botany, a genus of the hexandria digynia clafs. The calix has two leaves; the petals are two, and finuated; and there is but one feed. There are two fpecies; viz. the fpinofa, a native of Media; and the undulata, a native of Æthiopia.

ATRÆTI, in medicine, infants having no perforation in the anus, or perfons imperforated in the vagina or urethra.

ATRI, a town of the Farther Abruzzo, in the kingdom of Naples, fituated in 15° 20′ E. long. and 42° 40′ N lat.

ATRICAPILLA, in ornithology, a trivial name of a fpecies of mufcicapa; and alfo of a fpecies of motacilla. See MUSCICAPA, and MOTACILLA.

ATRICES, or ATTRICES, in medicine, tubercles about the anus, reckoned a kind of condylomata.

ATRICI, in furgery, fmall finufes in the extremity of the inteftinum rectum, which do not perforate into its cavity.

ATRIPLEX, in botany, a genus of the polygamia monœcia clafs. The calix of the hermaphrodite flower has five leaves; it has no corolla; the ftamina are five, and the ftylus is divided into two parts; there is but one depreffed feed. The calix of the female flower has two leaves; it has no corolla nor ftamina; the ftylus is divided into two parts; and there is but one depreffed feed. The fpecies are 12, of which eight are natives of Britain; viz. the portulacoides, or fea-purflain; the lacineata, or jagged fea-orache; the haftata, or fpear-leaved orache; the erecta, or wild orache; the patula, or narrow-leaved orache; the ferrata, or indented

indented ſea-orache; the littoralis, or graſs-leaved orache, and the pedunculata, or ſtalked ſea-orache.

ATROPA, in botany, a genus of the pentandria monogynia claſs. The corolla is ſhaped like a bell; the ſtamina are diſtant; the berry is globular, and conſiſts of two cells or apartments. The ſpecies are five; viz. 1. The mandragora, or mandrake, a native of Spain and the Eaſt. The mandrake is divided into male and female. The male mandrake has a very large, long, and thick root; it is largeſt at the top or head, and from thence gradually grows ſmaller. Sometimes it is ſingle and undivided to the bottom: but more frequently it is divided into two, ſometimes into three, or more parts. From this root there ariſe a number of very long leaves, broadeſt in the middle, narrow towards the baſe, and obtuſely pointed at the end; they are of a foot or more in length, and five inches or thereabouts in breadth; they are of a duſky and diſagreeable green colour, and of a very fœtid ſmell. The female mandrake perfectly reſembles the other in its manner of growth: but the leaves are longer and narrower, and of a darker colour, as are alſo the ſeeds and roots. Authors have ſpoken very largely and idly of the virtues of this plant. The moſt common quality attributed to it, is that of rendering barren women fruitful: but we have no tolerable foundation for this: what we certainly know of it is, that it has a ſoporific virtue like that of opium; and the bark in ſmall doſes, Herman aſſures us, has often been known to do great ſervice in hyſteric complaints; but it ſhould be uſed ſparingly, otherwiſe it will often bring on convulſions, and many other miſchievous ſymptoms. The ancients uſed it when they wanted a narcotic of the moſt powerful kind. 2. The balladona, or deadly night-ſhade, a native of Britain: the berries are poiſonous. 3. The phyſalodes, a native of Peru. 4. The fruteſcens, a native of Spain; and, 5. The arboreſcens, a native of America.

ATROPHY, in medicine, a diſeaſe, wherein the body, or ſome of its parts, do not receive the neceſſary nutriment, but waſte and decay inceſſantly. See MEDICINE.

ATTACHING, or ATTACHMENT, in Engliſh law, the taking or apprehending of a perſon, by virtue of a writ or precept.

ATTACHMENT *out of the Chancery*, is obtained upon an affidavit made, that the defendant was ſerved with a ſubpœna, and made no appearance; or it iſſueth upon not performing ſome order or decree.

ATTACHMENT *out of the Foreſt*, is one of the three courts held in the Foreſt. The loweſt court is called the *court of Attachment*, or *wood-mote court*; the mean, *ſwan mote*; and the higheſt, the *juſtice in eyre's ſeat*. This attachment is by three means, by goods and chattels, by body, pledges, and mainprize, or the body only. This court is held every forty days throughout the year, whence it is called the *forty-days court*.

ATTACHMENT *of privilege*, is by virtue of a man's privilege to call another to that court whereto he himſelf belongs, and in reſpect whereof he is privileged to anſwer ſome action.

ATTACHMENT *bonorum*, in the old Engliſh ſtatute books, imports a diſtreſs taken upon the goods or chattels of a perſon ſued for a perſonal eſtate, or debt, by the legal attachiators, or bailiffs, as a ſecurity to anſwer the action.

ATTAINDER, in Scots law. See TREASON.

ATTAINT, in law, a writ which lies againſt a jury that have given a falſe verdict in any court of record, in a real or perſonal action, where the debt or damages amount to above forty ſhillings.

ATTAINT, among farriers, a knock or hurt in a horſe's leg, proceeding either from a blow with another horſe's foot, or from an over-reach in froſty weather, when a horſe being rough-ſhod, or having ſhoes with long calkers, ſtrikes his hinder feet againſt his fore-leg.

ATTAINTED, in law, is applied to a perſon's being found guilty of any crime or offence, eſpecially treaſon or felony, by due courſe of law.

ATTELABUS, in zoology, a genus of inſects belonging to the order of coleoptera or beetle-kind. It has four wings, of which the ſuperior is cruſtaceous, and ſerve as a ſheath or cover to the inferior, which are membranous. The head tapers behind, and is inclined; the feelers turn thicker toward the apex. The ſpecies are 13; *viz* 1. The coryli is black, with red elytra or cruſtaceous wings. 2. The avellanæ is black, with the breaſt, feet, and elytra red. 3. The curculionoides is black, with red elytra and breaſt. The above three ſpecies frequent the leaves of the hazel and filbert nut-trees. 4. The ſurinamenſis has a double indentation (or two teeth) in the top of the elytra. It is a native of Surinam. 5. The penſilvanicus is black, with red elytra, a black belt round the middle, and another towards the apex of the elytra. It is a native of Philadelphia. 6. The melanurus is black, with teſtaceous elytra black at the apex. It is a native of Sweden. 7. The betulæ has ſaltatory or ſpringy legs, and the whole body is of a dark-red colour. It frequents the leaves of the birch-tree. 8. The formicarius is black, with red elytra, and a double white belt toward the baſe. It is a native of Europe. 9. The ſipylus is green, with a hairy breaſt, and a double yellow belt upon the elytra. 10. The apiarius is bluiſh, with red elytra, and three black belts. It is a native of Germany. 11. The mollis is yellowiſh and hairy, with pale elytra, and three belts. It is a native of Europe. 12. The ceramboides is of a blackiſh red colour, and the elytra is furrowed. It frequents the ſpongy boletus, a ſpecies of muſhroom. 13. The bupreſtoides is of a dark-red colour, with a globular breaſt, and nervous elytra. It is a native of Europe.

ATTENUANTS, medicines which reſolve the viſcoſity of the humours; thereby promoting their circulation, as well as the diſcharge of all noxious or excrementitious matter.

ATTESTATION, the act of affirming or witneſſing the truth of ſomething, more eſpecially in writing.

ATTIC,

ATTIC, any thing relating to Attica, or to the city of Athens: thus Attic falt, in philology, is a delicate poignant foit of wit and humour peculiar to the Athenian writers; Attic witnefs, a witnefs incapable of corruption, *&c.*

Attic, in architecture, a fort of building wherein the roof or covering is not to be feen; thus named, becaufe the buildings at Athens were generally of this form.

Attic *order*, a fmall order raifed upon a large one, by way of crowning, or to finifh the building; or it is, according to fome, a kind of rich pedeftal, fometimes ufed for the conveniency of having a wardrobe, or the like; and inftead of columns, has only pilafters of a particular form, and fometimes no pilafters at all.

The name Attic is alfo given to a whole ftory into which this order enters; this little order being always found over another greater one.

Attic *bafe*, a peculiar kind of bafe ufed by the ancient architects in the Ionic order; and by Palladio, and fome others, in the Doric.

ATTIRE, in botany. See Antheræ.

Attire, in hunting, fignifies the head or horns of a deer. The attire of a ftag, if perfect, confifts of bur, pearls, beam, gutters, antler, fur-antler, royal, fur-royal, and croches; of a buck, of the bur, beam, brow-antler, advancer, palm, and fpellers.

ATTITUDE, in painting and fculpture, the gefture of a figure or ftatue; or it is fuch a difpofition of their parts as ferves to exprefs the action and fentiments of the perfon reprefented.

ATTLEBURY, a market-town of Norfolk, about eighty miles north-eaft of London, fituated in 40′ E. long. and 52° 30′ N. lat.

ATTOCK, a city on the eaftern frontiers of Perfia, capital of a province of the fame name, and fituated on the river Attock, in 72° E. long. and 33° N. lat.

ATTOLLENS, in anatomy, an appellation given to feveral mufcles, otherwife called *levatores* and *elevatores*.

ATTORNEY, a perfon who by confent, commandment, or requeft, takes heed, fees, and takes upon him the charge of other mens bufinefs, in their abfence. Attorney is either general or fpecial: Attorney-general is he that by general authority is appointed to all our affairs or fuits; as the attorney-general of the king, which is nearly the fame with procurator Cæfaris in the Roman empire. Attorneys-general are made either by the king's letters-patent, or by our appointment before juftices in eyre, in open court. Attorney fpecial or particular, is he that is employed in one or more caufes particularly fpecified. There are alfo, in refpect of the divers courts, attorneys at large, and attorneys fpecial, belonging to this or that court only.

Attorneys in common law, are nearly the fame with proctors in the civil law, and folicitors in courts of equity. Attorneys fue out writs of procefs, or commence, carry on, and defend actions, or other proceedings, in the names of other perfons, in the courts of common law. None are admitted to act without having ferved a clerkfhip for five years, taking the proper oath, being enrolled, and examined by the judges. The attorney-general pleads within the bar. To him come warrants for making out patents, pardons, *&c.* and he is the principal manager of all law-affairs of the crown.

Letter of Attorney. See Letter.

Warrant of Attorney. See Warrant.

ATTOURNMENT, or Attornment, in law, a transfer from one lord to another of the homage and fervice a tenant makes; or that acknowledgment of duty to a new lord.

ATTRACTION, in natural philofophy, an indefinite term, applicable to all actions whereby bodies tend towards one another, whether in virtue of their weight, magnetifm, electricity, impulfe, or any other latent power. See Mechanics, Electricity, *&c.*

Elective Attractions. See Chemistry.

ATTRIBUTE, in a general fenfe, that which agrees with fome perfon or thing; or a quality determining fomething to be after a certain manner. Thus, underftanding is an attribute of mind, and extenfion an attribute of body. That attribute which the mind conceives as the foundation of all the reft, is called its effential attribute: thus extenfion is by fome, and folidity by others, efteemed the effential attributes of body or matter.

Attributes, in theology, the feveral qualities or perfections of the Divine nature, as wifdom, power, juftice, goodnefs, *&c.*

Attributes, in logic, are the predicates of any fubject, or what may be affirmed or denied of any thing.

Attributes, in painting and fculpture, are fymbols added to feveral figures, to intimate their particular office and character. Thus, the eagle is an attribute of Jupiter; a peacock, of Juno; a caduce, of Mercury; a club, of Hercules; and a palm, of Victory.

ATTRITION, the rubbing or ftriking of bodies one againft another, fo as to throw off fome of their fuperficial particles.

AVA, a kingdom of India, beyond the Ganges, fituated on the north eaft part of the bay of Bengal, between the countries of Arracan on the north, and Pegu on the fouth.

AVALON, a town of Burgundy in France, fituated in 3° 50′ E. long. and 47° 25′ N. lat.

AVARIA, in the cuftoms of Turky and Perfia, money exacted from Chriftians or Europeans, to be quit of fome falfe accufation formed on purpofe.

AVAST, in the fea-langue, a term requiring to ftop, or to ftay.

AVAUNCHERS, among hunters, the fecond branches of a deer's horns. See Head.

AUBAGNE, a town of Provence in France, fituated about feven miles fouthward of Marfeilles, in 5° 30′ E. long. 43° 15′ N. lat.

AUBANE, in the cuftoms of France, a right vefted in the king of being heir to a foreigner that dies within his dominions.

By this right the French king claims the inheritance of all foreigners that die within his dominions, notwithftand-

withſtanding of any teſtament the deceaſed could make. An ambaſſador is not ſubject to the right of aubane; and the Switz, Savoyards, Scots, and Portugueſe, are alſo exempted, being deemed natives and regnicoles.

AUBE, a river of France, which, ariſing in the ſouth-eaſt part of Champaigne, runs north-weſt, and falls into the Seine below Plancy.

AUBIGNE, a town of France, in the province of Berry, and government of Orleans, ſituated in 2° 20′ E. long. and 47° 3′ N. lat.

AUBIN, or *St* AUBIN, a town of Brittany in France; its W. long. being 1° 30′, and N. lat. 48° 15′.

AUBIN, in horſemanſhip, a broken kind of gate, between an amble and a gallop, accounted a defect.

AUBURN, a market-town in Wiltſhire, ſituated about 24 miles weſt of Reading, in 1° 40′ W. long. and 51° 30′ N. lat.

AUBUSSON, a town a France, in the province of Marche, and government of Lyonois: E. long. 2° 15′, and N. lat. 45° 55′.

AUCTION, a kind of public ſale, very much in uſe for houſehold-goods, books, plate, *&c.* By this method of ſale the higheſt bidder is always the buyer. This was originally a kind of ſale among the ancient Romans, performed by the public crier *ſub haſta*, i. e. under a ſpear ſtuck up on that occaſion, and by ſome magiſtrate, who made good the ſale by delivery of the goods.

AUCTION *by inch of candle*. See CANDLE.

AUDE, a river of France, which, taking its riſe in the Pyrenees, runs northwards by Alet and Carcaſſone; and from thence turning eaſtward through Languedoc, falls into the Mediterranean, a little to the north-eaſt of Narbonne.

AUDIANISM, the ſame with anthropomorphiſm. See ANTHROPOMORPHITES.

AUDIENCE, given to ambaſſadors, ceremonies obſerved in courts, at the admiſſion of ambaſſadors, or public miniſters, to a hearing.

In England, audience is given to ambaſſadors in the preſence-chamber; to envoys and reſidents, in a gallery, cloſet, or in any place where the king happens to be. Upon being admitted, as is the cuſtom of all courts, they make three bows, after which they cover and ſit down; but not before the king is covered and ſat down, and has given them the ſign to put on their hats.

When the king does not care to have them covered, and ſit, he himſelf ſtands uncovered; which is taken as a ſlight.

At Conſtantinople, miniſters uſually have audience of the prime vizier.

AUDIENCE-*court*, a court belonging to the archbiſhop of Canterbury, of equal authority with the arches-court, though inferior both in dignity and antiquity. The original of this court was, becauſe the archbiſhop of Canterbury heard ſeveral cauſes extrajudicially at home in his own palace; in which, before he would finally determine any thing, he uſually committed them to be diſcuſſed by men learned in the civil and canon laws, whom, thereupon, he called his auditors; and ſo in time it became the power of the man who is called *cauſarum negotiorumque audentiæ Cantuarienſis auditor, ſeu officinalis.*

Chamber of AUDIENCE. See CHAMBER.

AUDIT, a regular hearing and examination of an account by ſome proper officers, appointed for that purpoſe.

AUDITOR, in a general ſenſe, a hearer, or one who liſtens and attends to any thing.

AUDITOR, according to our law, is an officer of the king, or ſome other great perſon, who, by examining yearly the accounts of the under-officers, makes up a general book, with the difference between their receipts and charges, and their allowances to allocations.

AUDITOR *of the receipts*, is an officer of the exchequer who files the tellers bills, makes an entry of them, and gives the lord-treaſurer a certificate of the money received the week before. He alſo makes debentures to every teller, before they receive any money, and take their accounts. He keeps the black book of receipts, and the treaſurer's key of the treaſury, and ſees every teller's money locked up in the new treaſury.

AUDITORS *of the revenue*, or of the exchequer, officers who take the accounts of thoſe who collect the revenues and taxes raiſed by parliament, and take the accounts of the ſheriffs, eſcheators, collectors, tenants, and cuſtomers, and ſet them down in a book, and perfect them.

AUDITORS *of the preſt and impreſt*, are officers of the exchequer, who take and make up the accounts of Ireland, Berwick, the mint, and of any money impreſſed to any man for the king's ſervice.

AUDITORS *collegiate*, *conventual*, &c. officers formerly appointed in colleges, *&c.* to examine and paſs their accounts.

AUDITORY *nerves*, in anatomy. See p. 249.

AVAIL *of marriage*, in Scots law, that caſualty in ward-holding, by which the ſuperior was intitled to a certain ſum from his vaſſal, upon his attaining the age of puberty, as the value or avail of his tocher. See SCOTS LAW, tit. *Of caſualties due to the ſuperior*.

AVEIN, a town in the duchy of Luxemburg, remarkable for a victory which the French obtained over the Spaniards in 1635.

AVELLANA, in botany. See CORYLUS.

AVELLANA *purgatrix*, a name ſometimes given to the fruit of the ricinus. See RICINUS.

AVELLANE, in heraldry, a croſs, the quarters of which ſomewhat reſemble a filbert-nut. Sylvanus Morgan ſays, that it is the croſs which enſigns the mound of authority, or the ſovereign's globe.

AVELLINO, a town of the kingdom of Naples, and province of Principata, ſituated about 25 miles eaſt of the city of Naples, in 15° 20′ E. long. and 41° N. lat.

AVE-MARIA, the angel Gabriel's ſallutation of the the Virgin Mary, when he brought her the tidings of the incarnation.—It is become a prayer or form of devotion in the Romiſh church. Their chaplets and roſaries are divided into ſo many ave-maries, and ſo

many pater-nofters, to which the papifts afcribe a wonderful efficacy.

AVENA, oats, in botany, a genus of the triandria digynia clafs. The calix has a double valve; and the awn on the back is contorted. The fpecies are 13, fix of them natives of Britain; *viz.* 1. The nuda, or naked oats. 2. The fatua or bearded oat-grafs. 3. The pratenfis, or meadow oat-grafs. 4. The pubefcens, or rough oat-grafs. 5. The elatior, or tall oat-grafs. 6. The flavefcens, or yellow oat-grafs. It is remarkable, that the native place of the fativa, or common oat, cultivated in our fields, is almoft totally unknown. Anfon fays, that he obferved it growing wild or fpontaneoufly in the ifland of Juan Fernandez. But a vague obfervation from an author of that kind is not to be depended on.

AVENACEOUS, fomething belonging to, or partaking of the nature of oats.

AVENAGE, in law, a certain quantity of oats paid by a tenant to a landlord, inftead of rent, or fome other duties.

AVENOR, an officer belonging to the king's ftables, who provides oats for the horfes. He acts by warrant from the mafter of the horfe.

AVENS, in botany. See CARYOPHILLUS.

AVENTURE, in law books, means a mifchance, caufing the death of a perfon without felony.

AVENUE, in gardening, a walk planted on each fide with trees, and leading to an houfe, garden-gate, wood, *&c.* and generally terminated by fome diftant object. See GARDENING.

AVERAGE, in commerce, fignifies the accidents and misfortunes which happen to fhips and their cargoes, from the time of their loading and failing to their return and unloading; and is divided into three kinds. 1. The fimple or particular average, which confifts in the extraordinary expences incurred for the fhip alone, or for the merchandizes alone. Such is the lofs of anchors, mafts, and rigging, occafioned by the common accidents at fea; the damages which happen to merchants by ftorm, prize, fhipwreck, wet, or rotting; all which muft be born and paid by the thing which fuffered the damage. 2. The large and common average, being thofe expences incurred, and damages fuftained, for the common good and fecurity both of the merchandizes and veffels, confequently to be borne by the fhip and cargo, and to be regulated upon the whole. Of this number are the goods or money given for the ranfom of the fhip and cargo, things thrown overboard for the fafety of the fhip, the expences of unloading for entering into a river or harbour, and the provifions and hire of the failors when the fhip is put under an embargo. 3. The fmall averages, which are the expences for towing and piloting the fhip out of, or into harbours, creeks, or rivers, one third of which muft be charged to the fhip, and two thirds to the cargo.

Average is more particularly ufed for a certain contribution that merchants make proportionably to their loffes. It alfo fignifies a fmall duty which thofe merchants, who fend goods in another man's fhip, pay to the mafter for his care of them over and above the freight. Hence it is expreffed in the bills of lading, paying fo much freight for the faid goods, with primage and average accuftomed.

AVERANCE, or AURANCHE, a fea-port town in Normandy, in France, fituated in 1° 20′ W. long. and 48° 40′ N. lat.

AVER-CORN, that conveyed to the lord's granary by his tenants.

AVERDUPOIS, or AVOIRDUPOIS-WEIGHT, a fort of weight ufed in England, the pound whereof is made up of fixteen ounces. See WEIGHT.

This is the weight for the larger and coarfer commodities, fuch as groceries, cheefe, wool, lead, *&c.* Bakers, who live not in corporation-towns, are to make their bread by avoirdupois-weight, thofe in corporations by troy weight. Apothecaries buy by avoirdupois-weight, but fell by troy. The proportion of a pound avoirdupois to a pound troy is as 17 to 14.

AVERIA, in a general fenfe, fignifies any cattle, but is ufed in law for oxen, or horfes of the plough.

Replegiare de AVERIIS. See REPLEGIARE.

AVERNI, among ancient naturalifts, certain lakes, grottoes, and other places, which infect the air with poifonous fteams or vapours, called alfo *mephites*.

AVERRHOA, in botany, a genus of the decandria pentagynia clafs. The calix has five leaves; the petals are five, open at top; and the apple or fruit is pentagonal, and divided into five cells. The fpecies are three, all natives of India.

AVERHOISTS, the followers of Averhoes, a celebrated commentator of Ariftotle, who denied the natural immortality of the foul, and yet pretended to acquiefce in the Chriftian doctrine concerning it.

AVERRUNCI, in the ancient heathen theology, an order of deities among the Romans, whofe peculiar office it was to avert danger and exile. Apollo and Hercules are fuppofed to be of this order.

AVERSA, a town of Naples, in the province of Lavoro, fituated about 17 miles fouth of Capua, in 14° 45′ E. long. and 41° 15′ N. lat.

AVES, fome fmall iflands, belonging to the Dutch, on the coaft of Terra Firma, in South America.

AVESNES, a little fortified town of Hainault, in the French Netherlands; fituated about 21 miles fouth of Mons, in 3° 40′ E. long. and 50° 10′ N. lat.

AUGMENT, in grammar, an accident of certain tenfes of Greek verbs, being either the prefixing of a fyllable, or an increafe of the quantity of the initial vowels.

AUGMENTS, in mathematics. See FLUCTIONS.

AUGMENTATION, in a general fenfe, is the act of adding or joining fomething to another with a defign to render it large.

AUGMENTATION is alfo ufed for the additament or thing added.

AUGMENTATION was alfo the name of a court erected 27 Hen. VIII. fo called from the augmentation of the revenues of the crown, by the fuppreffion of religious houfes; and the office ftill remains, wherein there are many curious records, tho' the court has been diffolved long fince.

AUGMENTATION, in heraldry, are additional charges to

to a coat-armour, frequently given as particular marks of honour, and generally borne either in the escutcheon or a conton; as have all the baronets of England, who have borne the arms of the Province of Ulster in Ireland.

AUGRE, or AWGRE, an instrument used by carpenters and joiners to bore large round holes; and consisting of a wooden handle, and an iron blade terminated at bottom with a steel bit.

AUGSBURGH, a considerable city of Swabia, in Germany; situated in 11° E. long. and 48° 20′ N. lat. It is an imperial city, and remarkable for being the place where the Lutherans presented their confession of faith to the emperor Charles V. at a diet of the empire held in 1550, from hence denominated the *Augsburg confession*.

AUGUR, an officer among the Romans appointed to foretel future events, by the chattering and feeding of birds. There was a college or community of them, consisting originally of three members with respect to the three Luceres, Rhamnenses, and Tatienses: afterwards the number was increased to nine, four of whom were patricians and five plebeians. They bore an augural staff or wand, as the ensign of their authority; and their dignity was so much respected, that they were never deposed, nor any substituted in their place, though they should be convicted of the most enormous crimes. See AUGURY.

AUGURY, in antiquity, a species of divination, or the art of foretelling future events, is distinguished into five sorts. 1. Augury from the heavens. 2. From birds. 3. From chickens. 4. From quadrupeds. 5. From portentuous events. When an augury was taken, the augur divided the heavens into four parts, and having sacrificed to the gods, he observed, with great attention, from what part the sign from heaven appeared. If, for instance, there happened a clap of thunder from the left, it was taken as a good omen. If a flock of birds came about a man, it was a favourable presage; but the flight of vultures was unlucky. If, when corn was flung before the sacred chickens, they crouded about it, and eat it greedily, it was looked upon as a favourable omen; but if they refused to eat and drink, it was an unlucky sign. See the article DIVINATION.

AUGUST, in chronology, the eighth month of our year, containing thirty-one days. August was dedicated to the honour of Augustus Cæsar, because, in the same month, he was created consul, thrice triumphed in Rome, subdued Egypt to the Roman empire, and made an end of civil wars; being before called *Sexatilis*, or the sixth from March.

AUGUSTA, or AUSTA, an island in the gulph of Venice, on the coast of Damaltia; situated in 17° 40′ E. long. and 42° 35′ N. lat.

AUGUSTBURG, a city of Germany, in upper Saxony, upon the river Chop, six leagues south of Dresden.

AUGUSTALES, in Roman antiquity, an epithet given to the flamens or priests appointed to sacrifice to Augustus after his deification; and also to the ludi or games celebrated in honour of the same prince on the fourth of the ides of October.

AUGUSTALIA, a festival instituted by the Romans in honour of Augustus Cæsar, on his return to Rome, after having settled peace in Sicily, Greece, Syria, Asia, and Parthia; on which occasion they likewise built an altar to him, inscribed *Fortunæ reduci*.

AUGUSTALIS *Præfectus*, a title peculiar to a Roman magistrate who governed Egypt, with a power much like that of a proconsul in other provinces.

AUGUSTINE, or *St.* AUGUSTINE, the capital town of Spanish Florida in North America; situated near the frontiers of Georgia, in 81° W. long. and 30° N. lat.

CAPE-AUGUSTIN, a cape of Brazil, in South America; lying in 35° W. long. and 8° 30 S. lat.

AUGUSTINS, a religious order in the church of Rome, who follow the rule of St. Augustin, prescribed them by pope Alexander IV. Among other things, this rule enjoins to have all things in common, to receive nothing without the leave of their supeior; and several other precepts relating to charity, modesty, and chastity. There are likewise nuns of this order.

The Augustins are clothed in black, and at Paris are known under the name of the *Religious of St. Genevieve*, that abbey being the chief of the order.

AUGUSTINUS, the name of Jansenius's treatise, from which are collected the five famous propositions enumerated under the article Jansenism. See JANSENISM.

AVIARY, a place set apart for feeding and propagating birds. It should be so large, as to give the birds some freedom of flight; and turfed, to avoid the appearance of foulness on the floor.

AVICIENNA, in botany. See BONTIA.

AVIGLIANO, a small town of Piedmont in Italy; situated about seven miles west of Turin, in 7° E. long. and 44° 40′ N. lat.

AVIGNON, a large city of Provence in France, situated on the east side of the river Rhone, about 20 miles south of Orange, in 4° 40′ E. long. and 43° 50° N. lat. It is an archbishop's see, and, with the whole district of Venaissine, subject to the pope.

AVIGNON-BERRY, a name by which some call the fruit of the lycium, used in dying yellow. See LYCIUM.

AVILA, a beautiful city of Old Castile in Spain, situated 50 miles N. W. of Madrid, in 5° 20′ W. long. and 40° 50′ N. lat.

AVILES, a sea-port town of Austria in Spain, in 6° 40′ W. long. and 43° 30′ N. lat.

AVIS, bird, in zoology. See NATURAL HISTORY.

AVIS *artica*. See LARUS.

AVIS *nivis*. See LOXIA.

AVIS *paradisi*. See MUSCICAPA.

AVIS *pollyglotta*. See TURDUS.

AVIS *rabo*. See PELICANUS.

AVIS *rabos*. See PHAETON.

AVIS *venti*. See MARGUS.

AVIS is also the name of an order of knighthood in Portugal, instituted by Sancho the first king, in imitation of the order of Alcantara, whose great cross they wear.

AVISO, a term chiefly used in matters of commerce, to denote an advertisement, an advice, or piece of intelligence. See ADVICE.

AUKLAND, a market-town on the river Ware, in the bishopric of Durham, situated about 12 miles S. W. of the city of Durham, in 1° 25′ W. long. and 54° 40′ N. lat.

AULCESTER, a market-town of Warwickshire, situated about fourteen miles south west of Warwick, in 1° 50′ W. long. and 53° 20′ N. lat.

AULIC, an epithet given to certain officers of the empire, who compose a court which decides, without appeal, in all processes entered in it. Thus we say, *aulic council, aulic chamber, aulic counsellor.*

The aulic council is composed of a president, who is a catholic; of a vice-chancellor, presented by the archbishop of Mentz; and of eighteen counsellors, nine of whom are protestants, and nine catholics. They are divided into a bench of lawyers, and always follow the emperor's court; for which reason they are called *justitium imperatoris*, the emperor's justice, and aulic council. The aulic court ceases at the death of the emperor, whereas the imperial chamber of Spire is perpetual, representing not only the deceased emperor, but the whole Germanic body, which is reputed never to die.

Aulic, in the Sorbonne and foreign universities, is an act which a young divine maintains upon being admitted a doctor in divinity. It begins by an harangue of the chancellor, addressed to the young doctor, after which he receives the cap, and presides at the aulic, or disputation.

AULOS, a Grecian long measure, the same with stadium.

AUMBRY, a country-word denoting a cup-board.

AUME, a Dutch measure for Rhenish wine, containing forty English gallons.

AUNCEL-WEIGHT, an ancient kind of balance, now out of use, being prohibited by several statutes, on account of the many deceits practised by it. It consisted of scales hanging on hooks, fastened at each end of a beam, which a man lifted up on his hand. In many parts of England, auncel-weight signifies meat sold by the hand, without scales.

AUNE, a long measure used in France to measure cloths, stuffs. ribbons, *&c.* At Rouen it is equal to one English ell; at Calais, to 1.52; at Lyons, to 1.016; and at Paris, to 0.95.

AUNIS, a maritime province of France, on the western shore of the Bay of Biscay, having the province of Poictou on the north, and Santoigne on the south.

AVOCATORIA, a mandate of the emperor of Germany, addressed to some prince, in order to stop his unlawful proceedings in any cause appealed to him.

AVOIDANCE, in the canon law, is when a benefice becomes void of an incumbent, which happens either in fact, as by the death of the person; or in law, as by cession, deprivation, resignation, *&c.* In the first of these cases, the patron must take notice of the avoidance, at his peril; but in avoidance by law, the ordinary is obliged to give notice to the patron, in order to prevent a lapse.

AVON, a river of England, which, taking its rise in Wiltshire, runs by Bath, where it becomes navigable, and continues its course towards Bristol, below which city it falls into the Severn.

Avon is also a river, which, rising in Leicestershire, runs south-west by Warwick and Evesham, and falls into the Severn at Tewksbury in Gloucestershire.

AVOSETTA, in ornithology. See Recurvirostra.

AVOWEE, one who has a right to present to a benefice. See Advowson.

He is thus called in contradistinction to those who only have the lands to which the advowson belongs for a term of years, or by virtue of intrusion or disseisin. See Intrusion, *&c.*

AVOWRY, in law, is where a person distrained sues out a replevin; for then the distrainer must vow, and justify his plea, which is called his avowry. See Repleven.

AURA, among physiologists, signifies a vapour or exhalation, such as those which arise from mephitical caves. See Mephitis, and Exhalation.

Aura *vitalis*, in chemistry, a term used by Helmont, for what others call the *flamma vitalis*, or *vital flame.*

Aura, in ornithology, the trivial name of a species of vulture. See Vulture.

AURACH, a town of Swabia in Germany, situated about 15 miles east of Tubingen, in 9° 20′ E. long. and 48° 25′ N. lat.

AURANCHES, a large, strong, and well fortified city of France in the Lower Normandy, situated in 1° 16′ W. long. and 48° 41′ N. lat.

AURANTIUM, in botany. See Citrus.

AURATA, in ichthyology, the trivial name of a species of sparus. See Sparus.

AURATUS *eques*. See Eques Auratus.

AURAY, a sea-port town of Brittany in France, situated about 18 miles south-east of Port-Lewis, in 2° 45′ W. long. and 47° 40′ N. lat.

AURELIA, in natural history, the same with what is more usually called *chrysalis*, and sometimes *nymph.* See Chrysalis.

AURELIANA, in botany. See Pinax.

AURENGABAD, a large city in the province of Visiapour in India, on this side the Ganges; E. long. 5° 30′, and N. lat. 19° 15′.

AUREOLA, in its original signification, signifies a jewel, which is proposed as a reward of victory in some public dispute. Hence, the Roman schoolmen applied it to denote the reward bestowed on martyrs, virgins, and doctors, on account of their works of supererogation; and painters use it to signify the crown of glory, with which they adorn the heads of saints, confessors, *&c.*

AUREUS, a Roman gold coin, equal in value to twenty-five denarii.

AURICH, a town of Westphalia in Germany, situated about 12 miles north-east of Embden, in 6° 50′ E. long. and 53° 40′ N. lat.

AURICHALCUM, or Orichalcum. See Orichalcum.

AURICLE, in anatomy, that part of the ear which is prominent from the head, called by many authors *auris externa.* See p. 295.

AURI-

AURICLES are likewise two muscular bags situated at the basis of the heart. See p. 279.

AURICULA, in botany, a synonime of the dodecatheon and several other plants. See DODECATHEON, PRIMULA, ARENARIA, &c.

AURICULARIS DIGITUS, the little finger, so called, because it is used commonly to pick the ear.

AURIGA, *the Wagoner*, in astronomy, a constellation of the northern hemisphere. See ASTRONOMY, p. 486.

AURILLAC, a neat and well-built city of France, in the Upper Avergne, noted for its trade in bone-lace: it is situated in 30° 31′ E. long and 54° 44′ N. lat.

AURIPIGMENTUM, orpiment, in natural history. See ORPIMENT.

AURISCALPIUM, an instrument to clean the ears, and serving also for other operations in disorders of that part.

AURORA, the morning-twilight, or that faint light which appears in the morning, when the sun is within eighteen degrees of the horizon.

AURORA BOREALIS, is an extraordinary meteor, shewing itself in the night time, in the northern part of the heavens. See PNEUMATICS, *Of Meteors*.

AURUM, gold, in natural-history. See CHEMISTRY, *Of metals*.

AUSPEX, a name anciently used for augur. See AUGUR.

AUSTRAL, something relating to the south: thus the six signs on the south side of the equinoctial are called *austral signs*.

AUSTRAL *Fish*, a small constellation of the southern hemisphere, invisible to us.

AUSTRIA, a circle of Germany, comprehending the arch-duchy of Austria, also Styria, Carinthia, Carniola, Tyrol, Trent, and Brixen. It is bounded by Bohemia and Moravia on the north; by Hungary, Sclavonia, and Croatia on the east; by the dominions of Venice on the south, and by Bavaria on the west.

AUSTRIAN *Netherlands*. See NETHERLANDS.

AUTHENTIC, something of acknowledged and received authority. In law, it signifies something clothed in all its formalities, and attested by persons to whom credit has been regularly given. Thus we say, authentic papers, authentic instruments.

AUTHOR, properly signifies one who created or produced any thing. Thus God, by way of eminence, is called the author of nature, the author of the universe.

AUTHOR, in matters of literature, a person who has composed some book or writing.

AUTHORITY, in a general sense, signifies a right to command, and make one's self obeyed. In which sense, we say, the royal authority, the episcopal authority, the authority of a father, &c. It denotes also the testimony of an author, some apophthegm or sentence of an eminent person quoted in a discourse by way of proof.

Authority is represented, in painting, like a grave matron sitting in a chair of state, richly clothed in a garment embroidered with gold, holding in her right-hand a sword, and in her left a sceptre. By her side is a double trophy of books and arms.

AUTO DE FE, act of faith. See ACT *of faith*.

AUTOGRAPH, denotes a person's hand-writing, or the original manuscript of any book, &c.

AUTOMATUM, or AUTOMATON, an instrument, or rather machine, which by means of springs, weights, &c. seems to move itself, as a watch, clock, &c. Such also were Archytus's flying dove, Regiomontanus's wooden-eagle, &c.

AUTUMN, the third season of the year, when the harvest and fruits are gathered in.—Autumn is represented, in painting, by a man at perfect age, clothed like the vernal, and likewise girded with a starry girdle; holding in one hand a pair of scales equally poised, with a globe in each; in the other a bunch of divers fruits and grapes. His age denotes the perfection of this season; and the balance, that sign of the zodiac which the sun enters when our autumn begins.

AUTUMNAL *Point*, is that part of the equinox from which the sun begins to descend towards the south pole.

AUTUMNAL *Signs*, in astronomy, are the signs Libra, Scorpio, Sagittarius, through which the sun passes during the autumn.

AUTUMNAL *Equinox*, that time when the sun enters the autumnal point.

AUTUN, a city of Burgundy in France, situated on the river Arroux, in 4° 15′ E. long. and 46° 50′ N. lat.

AUVERGNE, a territory of the Lyonois in France; lying between the Bourbonois on the north, and the Cevennes on the south.

AUX, in astronomy, the same with the apogeum of the ancients, or the aphelium of the moderns. See APOGEUM and APHELIUM. It also denoted the arch of the ecliptic, intercepted between the first degree of Aries and the apogeum.

AUX, or AUGH, in geography, the capital city of Gascony in France. It is one of the richest archbishop's sees in France, though but a small town; situated in 20′ E. long. and 43° 40′ N. lat.

AUXERRE, a city of Burgundy, in France, situated on the river Yonne, in 3° 35′ E. long. and 47° 40′ N. lat.

AUXILIARY, whatever is aiding or helping to another.

AUXILIARY *Verbs*, in grammar, are such as help to form or conjugate others; that is, are prefixed to them, to form or denote the moods or tenses thereof; as *to have* and *to be*, in the English; *etre* and *avoir*, in the French; *ho* and *sono* in the Italian, &c.

In the English language, the auxiliary verb *am*, supplies the want of passive verbs.

AUXONE, a small city of Burgundy, in France, situated on the river Soane, about seven miles west of Dole, in 5° 22′ E. long. and 47° 15′ N. lat.

AWARD, in law, the judgment of an arbitrator, or of one who is not appointed by the law a judge, but chosen by the parties themselves for terminating their difference. See ARBITER.

AWL, among shoe-makers, an instrument wherewith holes are bored through the leather, to facilitate the stitching or sewing the same. The blade of the awl is usually a little flat and bended, and the point ground to an acute angle.

AWME, or AUME, a Dutch liquid measure containing

eight ſteckans, or twenty verges or verteels, equal to the tierce in England, or to one ſixth of a tun of France.

AWN, in botany. See ARISTA.

AWNING, in the ſea-language, is the hanging a ſail, tarpaulin, or the like, over any part of the ſhip, to keep off the ſun, rain, or wind.

AX-VETCH. See SECURIDACA.

AXBRIDGE, a market-town of Somerſetſhire, ſituated about eight miles north-weſt of Wells, in 3° W. long. and 51° 30′ N. lat.

AXEL, a ſmall fortified town of Dutch Flanders, ſituated about 20 miles weſt of Antwerpt, in 3° 40′ E. long. and 51° 20′ N. lat.

AXILLA, in anatomy, the arm-pit, or the cavity under the upper part of the arm.

AXILLA, in botany, the angle formed by a branch and the ſtem, or a leaf and the branch.

AXIM, a town on the Gold Coaſt of Guinea, where the Dutch have a fort and factory, called *St. Anthony:* 4° W. long. and 5° N. lat.

AXIOM, in philoſophy, any plain, ſelf-evident, and received notion, that cannot be made more plain and evident by demonſtration. It is alſo an eſtabliſhed principle in ſome art or ſcience.

AXIOPOLIS, a town of Bulgaria, ſubject to the Turks. It ſtands upon the river Danube.

AXIS, in geometry, the ſtraight line in a plain figure, about which it revolves, to produce or generate a ſolid: thus, if a ſemi-circle be moved round its diameter at reſt, it will generate a ſphere, the axis of which is that diameter.

AXIS, in aſtronomy, is an imaginary right line ſuppoſed to paſs through the centre of the earth, and the heavenly bodies, about which they perform their diurnal revolutions.

AXIS, in conic-ſections, a right line dividing the ſection into two equal parts, and cutting all its ordinates at right angles. See CONIC SECTIONS.

AXIS, in mechanics. The axis of a balance is that line about which it moves, or rather turns about. Axis of oſcillation is a right line parallel to the horizon, paſſing through the centre about which a pendulum vibrates. See MECHANICS.

AXIS *in peritrochio*, one of the five mechanical powers, conſiſting of a peritrochium or wheel concentric with with the baſe of a cylinder, and moveable together with it about its axis. See MECHANICS.

AXIS, in optics, is that particular ray of light coming from any object which falls perpendicularly on the eye. See OPTICS.

AXIS, in architecture, ſpiral axis, is the axis of a twiſted column drawn ſpirally, in order to trace the circumvolutions without.

Axis of the Ionic capital, is a line paſſing perpendicularly through the middle of the eye of the volute. See ARCHITECTURE.

Axis of a veſſel is an imaginary right line paſſing through the middle of it perpendicularly to its baſe, and equally diſtant from its ſides.

AXIS, in anatomy, the ſecond vertebra of the neck, ſo called from the head's turning on it like an axis.

AXIS, in zoology. See CERVUS.

AXMINSTER, a market-town of Devonſhire, ſituated about 22 miles eaſt of Exeter, in 3° 15′ W. long. and 50° 40′ N. lat.

AXUMA, a city of Ethiopia in Africa, ſituated in 38° E. long. and 15° N. lat.

AXUNGIA, in a general ſenſe, denotes old lard, or the drieſt and hardeſt of any fat in the bodies of animals: But, more properly, it ſignifies only hogs-lard.

AXUNGIA *ſolis*, in natural hiſtory, the ſame with the Sileſian earth.

AXUNGIA *vitri*, SANDIVER, or SALT *of glaſs*, a kind of ſalt which ſeparates from the glaſs while it is in fuſion. It is of an acrimonious and biting taſte. The farriers uſe it for cleanſing the eyes of horſes. It is alſo made uſe of for cleanſing the teeth; and is ſometimes applied to running ulcers, the herpes, or the itch, by way of deſiccative.

AXYRIS, in botany, a genus of the monœcia triandria claſs. The calix of the male is tripartite; it has no corolla. The calix of the female conſiſts of two leaves; it has two ſtyli, and one ſeed. The ſpecies are 4, none of them natives of Britain.

AYAMONTE, a ſea-port town of Andaluſia, in Spain, ſituated near the mouth of the river Guadiana, in 8° 5′ W. long. and 37° N. lat.

AYENIA, in botany, a genus of the gynandria pentandria claſs. The calix has two leaves; the petals are in the form of a ſtar, with long ungues; and the capſule has five cells. There are three ſpecies, all natives of the W. Indies.

AYRY, or AERY *of hawks*, a neſt or company of hawks, ſo called from the old French word *aire*, which ſignified the ſame.

AZAB, in the Turkiſh armies, a diſtinct body of ſoldiery, who are great rivals of the Janizaries.

AZALEA, in botany, a genus of the pentandria monogynia claſs. The corolla is bell-ſhaped; the ſtamina are inſerted into the receptacle; and the capſule has five cells. The ſpecies are ſix, moſt of them natives of America.

AZAMOR, a maritime city of Africa, in the kingdom of Morocco, and province of Duquela, ſituated in 6° 30′ W. long. and 32° 50′ N. lat.

AZAROLUS, in botany. See CRATÆGUS.

AZARUM, in botany. See ASARUM.

AZAZEL, the ſcape-goat, in Jewiſh antiquity. See SCAPE-GOAT.

AZED, in the materia medica, a kind of camphor. See CAMPHOR.

AZERADACH, in botany. See MELIA.

AZIMUTH, in aſtronomy, an arch of the horizon, intercepted between the meridian of the place and the azimuth, or vertical circle paſſing through the centre of the object, which is equal to the angle of the zenith, formed by the meridian and vertical circle; or it is found by this proportion, as the radius to the tangent of the latitude of the place, ſo is the tangent of

of the ſun's or ſtar's altitude, for inſtance, to the co-ſine of the azimuth from the ſouth, at the time of the equinox. To find the azimuth by the globe, ſee GEOGRAPHY.

Magnetical AZIMUTH, an arch of the horizon intercepted between the azimuth, or vertical circle, paſſing through the centre of any heavenly body, and the magnetical meridian. This is found by obſerving the object with an azimuth-compaſs.

AZIMUTH-*compaſs*, an inſtrument adapted to find, in a more accurate manner than by the common ſea-compaſs, the ſun or ſtars magnetical amplitude, or azimuth. See COMPASS.

AZIMUTH-*dial*, one whoſe ſtyle or gnomen is at right angles to the plane of the horizon.

AZIMUTH-*circles*, called azimuths, or vertical circles, are great circles of the ſphere, interſecting each other in the zenith and nadir, and cutting the horizon at right angles in all the points thereof.

AZOGA *ſhips*, are thoſe Spaniſh ſhips commonly called the *quick-ſilver ſhips*, from their carrying quick-ſilver to the Spaniſh W. Indies, in order to extract the ſilver out of the mines of Mexico and Peru. Theſe ſhips, ſtrictly ſpeaking, are not to carry any goods unleſs for the king of Spain's account.

AZONI, in ancient mythology, a name applied by the Greeks to ſuch of the gods as were deities at large, not appropriated to the worſhip of any particular town or country; but acknowledged in general by all countries, and worſhipped by every nation. Theſe the Latins called *dii communes*. Of this ſort were the ſun, Mars, Luna, *&c.*

AZOPH, in geography. See ASOPH.

AZORES, iſlands in the Atlantic ocean, between 25° and 33° W. long. and between 36° and 40° N. lat. They belong to the Portugueſe, and are ſometimes called the Weſtern Iſles, as lying weſtward of Europe.

AZOTH, in ancient chemiſtry, the firſt matter of metals, or the mercury of a metal; more particularly that which they call the *mercury of philoſophers*, which they pretend to draw from all ſorts of metallic bodies.

AZURE, in a general ſenſe, the blue colour of the ſky. See SKY and BLUE.

AZURE, among painters, the beautiful blue colour, with a greeniſh caſt, prepared from the lapis lazuli, generally called *ultramarine*.

With greater propriety, however, azure ſignifies that bright blue colour prepared from the lapis armenus, a different ſtone from the lapis lazuli, though frequently confounded together. This colour is, by our painters, commonly called *Lambert's blue*.

AZURE, in heraldry, the blue colour in the arms of any perſon below the rank of a baron. In the eſcutcheon of a nobleman, it is called *ſapphire*; and in that of a ſovereign prince, *Jupiter*. In engraving, this colour is expreſſed by lines, or ſtrokes drawn horizontally.

AZURIUM, the name of a chemical preparation from two parts of mercury, one of ſulphur, and a fourth of ſal ammoniac, mixed in a mortar, put into a glaſs veſſel, and ſet over the fire till a bluiſh ſmoak ariſes, *&c.*

AZYGOS, in anatomy, a vein riſing within the thorax on the right ſide, having no fellow on the left; whence it is called *azygos*, or *vena ſine pari*. See ANATOMY, p. 237.

AZYMITES, in church-hiſtory, Chriſtians who adminiſter the euchariſt with unleavened bread. This is an appellation given by the Latin to the Greek church; who alſo call the Armenians and Maronites, who uſe unleavened bread in their office, by the name of *Azymites*.

AZYMOUS, ſomething unfermented, as bread, *&c.* made without leaven.

B

BAAR, a country of Swabia in Germany, in the principality of Furſtenberg, near the ſource of the Danube and the Necker.

BABELMANDEL, a little iſland at the entrance of the Red-ſea, from the Indian ocean; from whence the ſtraits of Babelmandel take their name.

BABOON, in zoology, a ſynonime of the ſimia ſphinx. See SIMIA.

BABYLON, a celebrated city of antiquity, ſuppoſed to have been ſituated on the river Euphrates, though not on its preſent channel, in 44° E. long. and 32° N. lat. But of this once ſo flouriſhing a city, there are now no remains; nor is even the place where it ſtood certainly known.

BABYLON was alſo an ancient city of Egypt, ſuppoſed to have ſtood where Grand Cairo does at preſent.

BABYROUSSA, in zoology, a ſynonime of a ſpecies of ſus. See SUS.

BACA, a town of Granada, in Spain, ſituated about 48 miles north-eaſt of the city of Granada, in 3° W. long. and 37° 30′ N. lat.

BACALIAU, or BARCALLAO. See BARCALLAO.

BACCA, berry, in botany, is uſed to ſignify ſuch fruits as conſiſt of a pericarpium full of juice and ſeeds, without any valves.

BACCARAT, a town of Lorrain upon the Meuſe, between Nanci and Eſtival.

BACCASERAI, the capital city of Crim-Tartary, ſituated about 80 miles weſt of the ſtraits of Kaffa, in 35° E. long. and 45° 15′ N. lat.

BACCEM, or Baciaim, a ſea-port town of Cambaya, in the Hither Peninſula of India. It belongs to the Portugueſe, and is ſituated in 73° E. long. and 19° 20′ N. lat.

BACCHÆ, in antiquity, prieſteſſes of the god Bacchus. They were likewiſe called *mænades*, on account of the frantic ceremonies uſed in their feaſts; as alſo *thyades*, which ſignifies *impetuous* or *furious*. They celebrated the orgies of their god covered with ſkins of tigers and panthers, and running all the night, ſome with their hair looſe, with torches in their hands, others crowned with vine and ivy leaves, carrying a thyrſus or rod, turned about with ivy, in their hand. Along with them went cymbal-players and drummers, while they themſelves, ſeized with enthuſiaſm, made hideous lamentations.

BACCHANALIA, feaſts celebrated in honour of Bacchus by the ancient Greeks and Romans; of which the two moſt remarkable were called the *greater* and *leſſer*. The latter, called *lenæa*, from a word ſignifying a *wine-preſs*, were a preparation for the for the former, and were held in the open fields about autumn; but the greater, called *Dionyſia*, from one of the names of Bacchus, were celebrated in the city, about the ſpring-time. Both theſe feaſts were accompanied with games, ſpectacles, and theatrical repreſentations; and it was at this time the poets contended for the prize of poetry. Thoſe who were initiated into the celebration of the feaſts, repreſented, ſome Silenus, others Pan, others ſatyrs; and in this manner appeared in public night and day, counterfeiting drunkenneſs, dancing obſcenely, committing all kinds of licentiouſneſs and debauchery, and running over the mountains and foreſts, with horrible ſhrieks and howlings, crying out, *Io Bacche*. Livy informs us, that during the Bacchanalian feaſts at Rome, ſuch ſhocking diſorders were practiſed under the cover of the night, and thoſe who were initiated were bound to conceal them with an oath, attended with horrid imprecations, that the ſenate ſuppreſſed them firſt in Rome, and afterwards throughout all Italy.

BACCHARAC, or Bacherac. See Bacherac.

BACCHARIS, in botany, a genus of the ſyngeneſia polygamia ſuperflua claſs. The receptacle is naked, and the pappus briſtly; the calix is imbricated and cylindrical; the hermaphrodite floſcules are intermixed with the female ones. The ſpecies are ſeven, all natives of warm climates.

BACCHIUS, in ancient poetry, a kind of foot compoſed of a ſhort ſyllable, and two long ones, as the word [ăvārī]. It takes its name from the god Bacchus, becauſe it frequently entered into the hymns compoſed in his honour. The Romans called it likewiſe *ænotrius*, *tripodius*, *ſaltans*.

BACHARIS, in botany. See Baccharis.

BACHELOR. See Batchelor.

BACHERAC, a town of the Palatinate of the Rhine, ſituated on the weſtern ſhore of that river, in 7° E. lon. and 50° N. lat. It is remarkable for excellent wine, from thence called *Bacherac*.

BACHIAN, one of the Molucca iſlands, ſituated under the equator, in 125° E. long. It belongs to the Dutch.

BACHU, a ſea-port town of the province of Chirwan, or Shirvan, in Perſia. It is ſituated on the weſtern ſhore of the Caſpian ſea, in 49° E. long. and 40° N. lat.

BACK, in anatomy. See Back-*bone*.

Back, in the menage. To back a horſe, or mount a horſe *a dos*, in French, is to mount him bare-backed, or without a ſaddle.

Back-*bone*, or Spine. See Anatomy, p. 166, 167.

Back-*gammon*, an ingenious game played with dice and tables, to be learned only by obſervation and practice.

Back *painting*. See Painting.

Back-*ſtaff*, in the ſea-language. See Navigation.

Back-*ſtays*. See Stays.

Back-*tack*, in Scots law: When a wadſetter, inſtead of poſſeſſing the wadſet-lands, grants a tack thereof to the reverſor for payment of a certain ſum in name of tack-duty, that tack is called a *back-tack*. See Scots Law, tit. *Redeemable rights*.

Back-*worm*, in falconry. See Filanders.

BACULE, in fortification, a kind of portcullis, or gate, made like a pit-fall with a counterpoiſe, and ſupported by two great ſtakes. It is uſually made before the corpade-guard, not far from the gate of a place.

BACULOMETRY, the art of meaſuring acceſſible or inacceſſible heights, by the help of one or more baculi, ſtaves, or rods. See Geometry.

BACULUS *divinatorius*. See Virgula Divina.

BADAJOX, a large fortified town of Spaniſh Eſtremadura, ſituated on the river Guadiana, in 7° 20′ W. long. and 38° 45′ N. lat.

BADALON, a town of Catalonia, in Spain, ſituated on the Mediterranean, about ten miles eaſt of Barcelona, in 2° 15′ E. long. and 41° 15′ N. lat.

BADEN, the name of ſeveral towns: 1. Of one about 20 miles north of Straſbourg, capital of the margraviate of the ſame name, and remarkable for its hot baths. 2. Of another town of Swabia, in the Briſgow; where are likewiſe ſeveral hot baths. 3. Of one in Switzerland, about 14 miles north-weſt of Zurich. 4. Of one in the circle of Auſtria, about 15 miles ſouth of Vienna.

BADENOCH, an inland country of Inverneſsſhire in Scotland, lying between Aberdeenſhire and Lochaber.

BADENWEILLER, a town of Germany, in the Briſgow, near the Rhine.

BADGER, in zoology, the Engliſh name of a ſpecies of Urſus. See Ursus.

Badger, in old law-books, one that was licenſed to buy corn in one place, and carry it to another to ſell, without incurring the puniſhment of an engroſſer.

BADIANE, or Bandian, the ſeed of a tree which grows in China, and ſmells like aniſe-ſeed. The Chineſe, and the Dutch in imitation of them, ſometimes uſe the badiane to give their tea an aromatic taſte.

BADIS, a fortreſs of Livonia, ſubject to Ruſſia, and ſituated 20 miles weſt of Revel, in 23° E. long. and 59° 15′ N. lat.

BÆTUS, in ichthyology. See COTTUS.

BÆTYLIA, anointed ſtones, worſhipped by the Phœnicians, by the Greeks before the time of Cecrops, and by other barbarous nations. They were commonly of a black colour, and conſecrated to ſome god, as Saturn, Jupiter, the Sun, *&c.*

BÆZA, a large city of Andaluſia in Spain. ſituated on the river Guadalquivir, in 3° 15′ W. long. and 37° 40′ N. lat.

BAFFETAS, or BASTAS, a cloth made of coarſe white cotton-thread, which comes from the Eaſt Indies. That of Surat is the beſt.

BAFFIN's *Bay*, a gulph of North America, running north-eaſt from Cape Farewell in Weſt Greenland, from 60° N. lat. to 80°.

BAG, in commerce, a term ſignifying a certain quantity of ſome particular commodity; as a bag of almonds, for inſtance, is about three hundred weight; of aniſe-ſeeds, from three to four hundred, *&c.*

Bags are uſed in moſt countries to put ſeveral ſorts of coin in, either of gold, ſilver, braſs, or copper. Bankers, and others, who deal much in current caſh, label their bags of money, by tying a ticket or note at the mouth of the bag, ſignifying the coin therein contained, the ſum total, its weight, and of whom it was received. Tare is allowed for the bag. See TARE and TRET.

BAG, among farriers, is when, in order to retrieve a horſe's loſt appetite, they put in an ounce of aſa-fœtida, and as much powder of ſavin, into a bag, to be tied to the bit, keeping him bridled for two hours, ſeveral times a-day; as ſoon as the bag is taken off, he will fall to eating. The ſame bag will ſerve a long time.

BAGDAT, a ſtrong town of Turky, on the frontiers of Perſia, ſituated on the river Tigris, in the province of Iracaarabic; it was formerly capital of the Saracen empire, and lies in 43° E. long. and 33° 20′ N. lat.

BAGGAGE, in military affairs, denotes the cloaths, tents, utenſils of divers ſorts, proviſions, and other neceſſaries belonging to the army.

Before a march, the waggons with the baggage are marſhalled according to the rank which the ſeveral regiments bear in the army; being ſometimes ordered to follow the reſpective columns of the army, ſometimes to follow the artillery, and ſometimes to form a column by themſelves. The general's baggage marches firſt; and each waggon has a flag, ſhewing the regiment to which it belongs.

BAGNAGAR, the capital of Golconda, in the Hither Peninſula of India, formerly the reſidence of the kings of Golconda, now ſubject to the mogul; in 77° 30′ E. long. and 16° 30′ N. lat.

BAGNIALUCK, a large city of Boſnia in European Turky, ſituated in 18°15′ E. long. and 44° N. lat.

BAGNIO, an Italian word, ſignifying a bath: We uſe it for a houſe with conveniencies for bathing, cupping, ſweating, and otherwiſe cleanſing the body; and ſometimes for worſe purpoſes. In Turky, it is become a general name for the priſons where the ſlaves are incloſed, it being uſual in theſe priſons to have baths

BAGNOLIANS, in church-hiſtory, a ſect of heretics, who in reality were Manichees, though they ſomewhat diſguiſed their errors. They rejected the Old Teſtament, and part of the New, held the world to be eternal, and affirmed that God did not create the ſoul when he infuſed it into the body.

BAGPIPE, a muſical inſtrument of the wind kind, chiefly uſed in country-places, eſpecially in the North. It conſiſts of two principal parts; the firſt a leathern bag, which blows up like a foot-ball, by means of a port-vent, or little tube, fitted to it, and ſtopped by a valve: the other part conſiſts of three pipes or flutes; the firſt called the *great pipe*, or *drone*; the ſecond, the *little one*; which paſs the wind out only at the bottom; the third has a reed, and is played on by compreſſing the bag under the arm, when full, and opening or ſtopping the holes, which are eight, with the fingers. The little pipe is ordinarily a foot long; that played on, 13 inches; and the port-vent, ſix.

BAGRE, in ichthyology, the trivial name of a ſpecies of ſilurus. See SILURUS.

BAGUETTE, in architecture, a ſmall round moulding, leſs than an aſtragal, and ſo called from the reſemblance it bears to a ring.

BAHAMA, or LUCAYA ISLANDS, a number of iſlands lying in the Atlantic Ocean, between 21° and 27° N. lat. and between 73° and 81° W. long.

Theſe iſlands, whereof twelve are of a conſiderable extent, take their name from Bahama, one of the largeſt of them, lying between 78° and 81° W. long. and between 26° and 27° N. lat.

BAHAR, or BARRE, in commerce, weights uſed in ſeveral places in the Eaſt Indies.

There are two of theſe weights, one the great bahar, with which they weigh pepper, cloves, nutmegs, ginger, *&c.* and contains five hundred and fifty pounds of Portugal, or about five huudred and twenty-four pounds nine ounces avoirdupois weight. With the little bahar, they weigh quickſilver, vermilion, ivory, ſilk, *&c.* It contains about four hundred and thirty-ſeven pounds nine ounces avoirdupois weight.

BACHAREN, an iſland in the Perſian gulf, in 50° E. long. and 26° N. lat.

BAHIR, a Hebrew term ſignifying famous or illuſtrious; but particularly uſed for a book of the Jews, treating of the profound myſteries of the cabbala, being the moſt ancient of the rabbinical works.

BAHUS, a city of Sweden, capital of a province of the ſame name, and ſituated about 20 miles north-weſt of Gottenburgh, in 11° E. long. and 58° 20′ N. lat.

BAJA, a town of Italy, in the kingdom of Naples, and province of Lavoro, ſituated in 14° 40′ E. long. and 41° 6′ N. lat.

BAJADOR, a cape on the weſt coaſt of Africa, in 15° W. long. and 27° N. lat.

BAIL, in Scots law: When a priſoner is ſet at liberty upon ſome perſon's becoming ſurety for his appearance to

to ſtand trial under a penalty, he is ſaid to be *admitted to bail.* See Scots Law, tit. *Crimes.*

Clerk of the Bails, is an officer belonging to the court of the King's Bench: he files the bail-pieces taken in that court, and attends for that purpoſe.

BAIL, or Bale, in the ſea-language. The ſeamen call throwing the water by hand, out of the ſhip or boat's-hold, *bailing.* They alſo call thoſe hoops that bear up the tilt of a boat, its *bails.*

BAILIAGE, or Bailiwick. See Bailiwick.

Water Bailiage, an ancient duty paid to the city of London, for all goods brought into, or carried out of, the port.

BAILIE, in Scots law, a judge anciently appointed by the king over ſuch lands not erected into a regality as happened to fall to the crown by forfeiture or otherwiſe, now aboliſhed. It is alſo the name of a magiſtrate in royal boroughs, and of the judge appointed by a baron over lands erected into a barony. See Scots Law, tit. *Inferior judges,* &c.

BAILIFF, an officer appointed for the adminiſtration of juſtice withing a certain diſtrict, called a *bailiwick.*

Bailiffs-*errant,* ſuch as are appointed by the ſheriff, to go up and down the country, to ſerve writs and warrants, ſummon country-courts, ſeſſions, aſſizes, and the like.

Bailiffs *of franchiſes,* thoſe appointed by every lord within his liberty to do ſuch offices therein as the bailiff-errant does at large in the country.

There are alſo bailiffs of foreſts, and bailiffs of manors, who direct huſbandry, fell trees, gather rents, pay quit-rents, *&c.*

Water-Bailiff, an officer appointed in all port-towns, for the ſearching of ſhips, gathering the toll for anchorage, *&c.* and arreſting perſons for debt, *&c.* on the water.

BAILIWICK, that liberty which is exempted from the ſheriff of the county; over which liberty the lord thereof appoints his own bailiff, with the like power within his precinct, as an under-ſheriff exerciſes under the ſheriff of the county: Or it ſignifies the precinct of a bailiff, or the place within which his juriſdiction is terminated.

BAILO, thus they ſtyle at Conſtantinople the ambaſſador of the republic of Venice, who reſides at the Porte. This miniſter, beſides his political charge, acts there the part of a conſul of Venice.

BAIOCAO, a copper-coin, current at Rome, and throughout the whole ſtate of the church, ten of which make a julio, and an hundred a Roman crown.

BAIRAM, in the Mahometan cuſtoms, a yearly feſtival of the Turks, which they keep after the faſt of Ramazan.

The Mahometans have two bairams, the great and the little. The little bairam holds for three days, and is ſeventy days after the firſt, which follows immediately the ramazan. During the bairam, the people leave their work for three days, make preſents to one another, and ſpend the time with great manifeſtations of joy. If the day after ramazan ſhould be ſo cloudy as to prevent the ſight of the new moon, the bairam is put off to the next day, when it is kept, even if the moon ſhould ſtill be obſcured; when they celebrate this feaſt, after numerous ceremonies, or rather ſtrange mimickries, in their moſque, it is concluded with a ſolemn prayer againſt the infidels, to extirpate Chriſtian princes, or to arm them againſt one another, that they may have an opportunity to extend the borders of their law.

BAIT, in fiſhing. See Fishing.

BAITING, in falconry, is when a hawk flutters with her wings, either from perch or fiſt, as if it were ſtriving to get away.

BAJULUS, an ancient officer in the court of the Greek emperors There were ſeveral degrees of bajuli, as the grand bajulus, who was preceptor to the emperor; and the ſimple bajuli, who were ſub-preceptors.

BAKAL, a great lake in the middle of Siberia, on the road from Muſcovy to China.

BAKER, a perſon whoſe occupation or buſineſs it is to bake bread. See Baking.

BAKEWELL, a large market town of Derbyſhire, about 150 miles from London. It is a good market for lead.

BAKING, the art of preparing bread, or reducing meals of any kind, whether ſimple or compound, into bread.

The various forms of baking among us may be reduced into two, the one for leavened, the other for unleavened bread; for the firſt, the chief is manchet-baking, the proceſs whereof is as follows.

The meal, ground and boulted, is put into a trough, and to every buſhel are poured in about three pints of warm ale, with barm and ſalt to ſeaſon it: this is kneaded well together with the hands through the brake; or for want thereof, with the feet, through a cloth; after which, having lain an hour to ſwell, it is moulded into manchets, which ſcorched in the middle, and pricked at top, to give room to riſe, are baked in the oven by a gentle fire.

For the ſecond, ſometimes called cheat-bread baking, it is thus: ſome leaven (ſaved from a former batch) filled with ſalt, laid up to ſour, and at length diſſolved in water, is ſtrained through a cloth into a hole made in the middle of the heap of meal in the trough; then it is worked with ſome of the flour into a moderate conſiſtence; this is covered up with meal, where it lies all night. and in the morning the whole heap is ſtirred up, and mixed with a little warm water, barm, and ſalt, by which it is ſeaſoned, ſoftened, and brought to an even leaven: it is then kneaded, moulded, and baked, as before.

Baking *of porcelain.* See Porcelain.

BALA, in geography, a market-town of Marionethſhire, about 16 miles ſouth from Denbigh, in 3° 40′ W. long. and 52° 55′ N. lat.

BALÆNA, or whale, in zoology, a genus of the mammalia claſs, belonging to the order of cete. The characters of this genus are theſe: The balæna, in place of teeth, has a horny plate in the upper jaw, and a double fiſtula or pipe for throwing out water. The ſpecies are four; viz. 1. The myſticetus, which has many turnings and windings in its noſtrils, and has no fin on the back. This is the largeſt of all animals; it is often

often 100 feet long: the head is very large in proportion to the body; and the lower jaw is much wider than the upper one: the ears are ſituated below the eyes. In the belly, it has two dugs a little before the vulva; there are two large fins on the breaſt; and the tail is forked. The myſticetus contains ſuch a large quantity of fat, that a ſhip is often loaded with the blubber obtained from a ſingle fiſh. It is a native of the Greenland Ocean. It feeds chiefly upon the medufa, a ſmall ſea-inſect. See MEDUSA. The ſubſtance called whale-bone is got from the upper lip, and towards the throat of this and all the other ſpecies of whales. See Plate LI. fig. 1. For the manner of taking whales, ſee WHALE-FISHERY. 2. The phyſalus, has a double pipe in the middle of the head, and a thick fat fin on the lower part of the back, beſides the two fins on the breaſt; it has no teeth; and the belly is ſmooth. The phyſalus inhabits the European and American oceans: it feeds upon herrings and other ſmall fiſh. 3. The boops has a double pipe in its ſnout, three fins like the former, and a hard horny ridge on its back. The belly is full of longitudinal folds or rugæ. It frequents the northern ocean. 4. The muſculus has a double pipe in its front, and three fins; the under jaw is much wider than the upper one. It frequents the Scotch coaſts, and feeds upon herrings —Linnæus makes the phyſeter and delphinus, which are ranked among the whales by ſome writers, two diſtinct genera. See PHYSETER and DELPHINUS.

BALAGNA, a town of Muſcovy, in the province of Novogorod, ſituated on the river Wolga, in 45° E. long. and 56° 30′ N. lat.

BALAMBUAN, a ſea-port town of the iſle of Java, in Aſia, which gives name to the channel called the *Streights of Balambuan.*

BALAM-PULLI, in botany. See TAMARINDUS.

BALANCE, or BALANCE See BALLANCE.

BALANGIAR, the capital city of Tartary, north of the Caſpian ſea.

BALANUS, in zoology, the trivial name of a ſpecies of lepas. See LEPAS.

BALANUS, in anatomy, a term ſometimes uſed for the glans penis, as well as for the clitoris.

BALANUS, in pharmacy, denotes a ſuppoſitory. See SUPPOSITORY.

BALASS, or BALLAS, the name of a kind of ruby. See RUBY.

BALAUSTIA, in botany. See PUNICA.

BALBASTRO, a city of Arragon, in Spain, ſituated upon the river Sinca, fifty miles north-eaſt of Saragoſſa.

BALBEC, a town of Aſiatic Turky, ſituated at the foot of mount Libanus, in 37° 30′ E. long. and 33° N. lat.

BALCHA, a city of Uſbbec Tartary, ſituated on the frontiers of Perſia, in 65° 20′ E. long. and 37° N. lat.

BALCONY, in architecture, a projecture in the front of a houſe, or other building, ſupported by pillars or conſoles, and encompaſſed with a baluſtrade.

BALDACHIN, or BALDAQUIN, in architecture, a building in form of a canopy, ſupported by pillars, and frequently uſed as a covering to inſulated altars. Some alſo uſe the term baldachin for the ſhell over a door.

BALDIVIA, or VALDIVIA, a ſea-port town of Chili, in South America, ſituated on the South Sea, in 80° W. long. and 40° S. lat.

BALDNESS, a defect of hair, owing to the want of a ſufficient ſupply of nutricious juice.

BALDOC, a market-town in Hertfordſhire, about 38 miles north of London, in 15′ W. long. and 51° 55′ N. lat.

BALE, in commerce: Any goods packed up in cloth, and corded round very tight, in order to keep them from breaking, or preſerve them from the weather, is called *a bale.*

A bale of cotton yarn is from three to four hundred weight; of raw ſilk, is from one to four hundred; of lockram or dowlaſs, either three, three and a half, or four pieces.

BALE-GOODS, among the Engliſh merchants, are all ſuch as are imported or exported in bales; but the French give that name to certain hard-wares, and other ſort of merchandize, which come to Paris, and are commonly made by bad workmen, of indifferent materials.

BALI, an iſland in the Eaſt Indies, ſituated in 114° E. long. and 7° 30′ S. lat. This iſland, and the eaſt end of the iſland of Java, form a ſtreight about a mile over, of extremely difficult paſſage.

BALISORE, a ſmall ſea-port of the Hither India, ſituated on the north-weſt part of the bay of Bengal, in 85° 15′ E. long. and 21° 30′ N. lat

BALISTA, or BALLISTA. See BALLISTA.

BALISTES, in ichthyology, a genus of fiſhes belonging to the order of amphibia nantes. The characters are theſe: The head is flat; there are eight teeth in each ſide, and the two anterior ones are longeſt; in the place of gills, the baliſtes has an aperture immediately above the pectoral fins; the body is flat, the ſcales are joined together by the ſkin, and the belly is keeled. The ſpecies of this genus are eight; viz. the baliſtes monoceros, whoſe head-fin conſiſts of but one ray, and the tail rays are carinated. It is called the *Unicorn-fiſh* by Cateſby, and is found in the Aſiatic and American ſeas. 2. The hiſpidus, whoſe head-fin is uniradiated; and there is a round black ſpot in the tail-fin. The body is rough and briſtly towards the tail. The ſpine or horn is ſituated between the eyes; the ſnout is ſubulated; and inſtead of a belly-fin, it has a jagged ſharp ſpine. This ſpecies is a native of Carolina. 3. The tomentoſus, whoſe head-fin is biradiated, and the body of it towards the hind-part is hairy. It is a native of America. 4. The papilloſus, has a biradiated back-fin, and a papillous body. 5. The verrucoſus, has a triradiated back-fin; and the tail is full of little warts. In place of a belly-fin this ſpecies has a large, thick, warty ray. It has 25 ſmall reverſed ſharp ſpines at the ſide of the tail, diſpoſed in four rows. It is a native of India. 6. The aculeatus has a triradiated back-fin; and the ſpines of the tail lean upon each other. It is alſo a native of India. 7. The vetula, has a triradiated back-fin; the belly-fin is longitudinal,

tudinal, and ſomewhat carinated; and the tail-fin is forked. It is found at Aſcenſion Iſland. 8. The ringens, has a triradiated back-fin; there are three folds on each ſide of the head, and the tail-fin is forked. This ſpecies is likewiſe found at Aſcenſion Iſland.

BALIVO *amovendo*, in law, was a writ for removing a bailiff from his office, for want of having ſufficient land in his bailiwick to anſwer the king and his people, according to the ſtatute of Weſtminſter, 2 reg. Orig. 78.

BALK, among builders, is ſometimes uſed for the ſummer-beam of a houſe; ſometimes for the poles and rafters, which ſupport the roofs of barns, *&c.*; and ſometimes for the beams uſed in making ſea-holds.

BALK, in agriculture, denotes a ridge, or bank between two furrows.

BALKE, or BALKHE, a city of Aſia, in the Uſbec Tartary, ſituated upon the river Dilhas, in 68° E. lon. and 36° 40′ N. lat.

BALL, in a general ſenſe, a ſpherical and round body, whether it be ſo naturally, or turned into that figure by the hand of an artiſt: Thus we ſay, a tennis-ball, foot-ball, cotton-ball, *&c.*

BALL, in the military art, comprehends all ſorts of bullets for fire-arms, from the cannon to the piſtol. See GUNNERY.

Cannon-balls are of iron; muſquet-balls, piſtol-balls, *&c.* are of lead. The experiment has been tried of iron balls for piſtols and fuſees, but they are juſtly rejected, not only on account of their lightneſs, which prevents then from flying ſtrait, but becauſe they are apt to furrow the barrel.

BALL *and ſocket* is an inſtrument made of braſs, with a perpetual ſcrew, ſo as to move horizontally, vertically, and obliquely; and is generally uſed for the managing of ſurveying, and aſtronomical inſtruments.

BALL *of a pendulum*, the ſame with bob. See BOB.

BALL, among printers. See PRINTING.

Puff-BALL, the Engliſh name of the lycoperdon. See LYCOPERDON.

BALLAD, or BALLET, a king of ſong, adapted to the capacity of the lower claſs of people; who, being mightily taken with this ſpecies of poetry, are thereby not a little influenced in the conduct of their lives. Hence we find, that ſeditious and deſigning men never fail to ſpread ballads among the people, with a view to gain them over to their ſide.

BALLANCE, or BALANCE, in mechanics, one of the ſimple powers, which ſerves to find out the equality or difference of weight in heavy bodies. See MECHANICS.

Hydroſtatical BALLANCE. See HYDROSTATICS.

BALLANCE *of trade*, in commerce, the equality between the value of the commodities bought of foreigners, and the value of the native productions tranſported into other nations. See COMMERCE.

BALLANCE *of a clock*, or *watch*. See CLOCK and WATCH-MAKING.

BALLANCE *fiſh*. See SQUALUS.

BALLANCER, in the hiſtory of inſects, a ſtyle, or oblong body, ending in a protuberance or head, found under each wing of the two-winged flies; theſe ſerve to poiſe the body of the fly.

BALLAST, a quantity of ſtones, gravel, or ſand, laid in a ſhip's hold, to make her ſink to a certain depth into the water, and ſail upright. The ballaſt is ſometimes one quarter, one third, or one half, according to the difference of the bulk of the ſhip. Flat veſſels require the moſt ballaſt. Ships are ſaid to be in ballaſt, when they have no other loading. Maſters of veſſels are obliged to declare the quantity of ballaſt they bear, and to unload it at certain places. They are prohibited unloading their ballaſt in havens, roads, *&c.* the neglect of which has ruined many excellent ports.

BALLASTAGE, or LASTAGE. See LASTAGE.

BALLERUS, in ichthyology, the trivial name of a ſpecies of cyprinus. See CYPRINUS.

BALLET. See BALLAD.

BALLIAGE, or BAILIAGE. See BAILIAGE.

BALLICONNEL, a town of Ireland, about 11 miles north-eaſt of Cavan, 7° 50′ W. long. 54° 6′ N. lat.

BALLIMORE, a town of Leinſter in Ireland, ſurrounded entirely with a marſh.

BALLISHANNON, a large town of the county of Donnegal, and province of Ulſter in Ireland, ſituated about ten miles ſouth of the town of Donnegal, in 8° 30′ W. long. and 54° 25′ N. lat.

BALLISTA, in antiquity, a military machine uſed by the ancients in beſieging cities, to throw large ſtones, darts, and javelins.

It reſembled our croſs-bows, though much larger and ſuperior in force

From this engine, ſtones of a ſize not leſs than mill-ſtones, were thrown with ſo much violence, as to daſh whole houſes in pieces at a blow. It is deſcribed thus: A round iron cylinder was faſtened between two planks, from which reached a hollow ſquare beam, placed croſs-wiſe, and faſtened with cords, to which were added ſcrews; at one end of this ſtood the ingineer, who put a wooden ſhaft with a big head into the cavity of the beam; this done, two men bent the engine by drawing ſome wheels: When the top of the head was drawn to the outmoſt end of the cords, the ſhaft was driven out of the balliſta, *&c.*

BALLISTES, in ichthyology. See BALISTES.

BALLOON, or BALLON, in a general ſenſe, ſignifies any ſpherical hollow body, of whatever matter it be compoſed, or for whatever purpoſes it be deſigned. Thus, with chemiſts, balloon denotes a round ſhort-necked veſſel, uſed to receive what is diſtilled by means of fire; in architecture, a round globe on the top of a pillar; and among engineers, a kind of bomb made of paſte-board, and played off in fire-works, either in the air or on the water, in imitation of a real bomb.

Balloon, in the French paper trade, is a term for a quantity of paper, containing 24 reams. It is alſo the name of a ſort of brigantine uſed in the kingdom of Siam.

BALLON, in geography, a town of France, in the dioceſe of Mans, upon the banks of the Orne, 50′ E. lon. 48° 10′ N. lat.

BALLOTA,

BALLOTA, in botany, a genus of the didynamia gymnofpermia clafs. The calix has four teeth; the fuperior lip of the corolla is concave and crenated. There are four fpecies, *viz.* the nigra, or ftinking horehound, a native of Britain; the alba and lanata, both natives of Europe; and the fuaveolens, a native of America.

BALLOTADE, in the menage, the leap of a horfe between two pillars, or upon a ftraight line, made with juftnefs of time, with the aid of the hand, and the calves of the legs; and in fuch a manner, that when his fore-feet are in the air, he fhews nothing but the fhoes of his hinder-feet without yerking out.

BALLS, or BALLETS, in heraldry, a frequent bearing in coats of arms, ufually denominated according to their colours, bezants, plates, hurts, *&c.* See BEZANTS.

BALLUSTER, a fmall kind of pillar ufed for balluftrades. See ARCHITECTURE.

BALLUSTRADE, a feries or row of ballufters, joined by a rail; ferving as well for a reft to the elbows, as for a fence or inclofure to balconies, altars, ftaircafes, *&c.* See ARCHITECTURE.

BALM, in botany. See MELISSA.

BALM, or BALSAM. See BALSAM.

BALNEUM, a term ufed by chemifts to fignify a veffel filled with fome matter, as fand, water, or the like, in which another is placed that requires a more gentle heat than the naked fire. Thus *balneum arenofum*, called alfo *balneum ficcum*, and fand-heat, is when the cucurbit is placed in fand, in afhes, or filings of fteel. *Balneum mariæ*, or *maris*, is when the veffel, containing the ingredients to be diftilled, *&c.* is put into a veffel of water; which is made to boil; fo that no greater heat than that of boiling water can be communicated to the fubftance to be treated. And *balneum vaporis*, or *vaporarium*, is, when two veffels are difpofed in fuch a manner, that the vapour, raifed from the water contained in the lower, heats the matter contained in the upper.

BALOTADE, or BALLOTADE. See BALLOTADE.

BALOWA, a city of Afia, in the kingdom of Decan.

BALSAM, or NATIVE BALSAM, an oily, refinous, liquid fubftance, flowing either fpontaneoufly, or by means of incifion, from certain plants. There are a great variety of balfams, generally denominated from the fubftances from which they are obtained. See CHEMISTRY, *Of refins and balfams.*

BALSAMICS, in pharmacy, foftening, reftoring, healing and cleanfing medicines, of a gentle attenuating nature.

Balfamics may be ufed, both internally and externally, in all difeafes of the head, nerves, ftomach, *&c.*

BALSAMINA, in botany, the trivial name of a fpecies of impatiens. See IMPATIENS.

BALSAMITA, in botany, a fynonime of a fpecies of xeranthemum. See XERANTHEMUM.

BALSARA, in geography, the fame with Baffora. See BASSORA.

BALTIC *fea*, that lying between Sweden on the north, and Germany and Livonia on the fouth.

BALTIMORE, a town of the county of Corke, and province of Munfter, in Ireland, fituated about five miles north of Cape Clear, in 9° 15′ W. long. and 51° 15′ N. lat.

BALZANE. See WHITEFOOT.

BAMBERG, a city of Franconia, in Germany, 10° 50′ E. long. and 50° 15′ N. lat.

The bifhop of Bamberg is fovereign of the city and diftrict round it, for fixty miles in length, and forty in breadth.

BAMBOE, in botany, the trivial name of a fpecies of arundo. See ARUNDO.

BAMFF, or BANFF, a town of Scotland, which gives name to a county, lying between Aberdeenfhire and Murray, along the fouthern bank of the river Spey.

The town is fituated at the mouth of the river Dovern.

BAMPTON, a market-town of Oxfordfhire, fituated on the river Ifis, about ten miles fouth-weft of Oxford, 1° 35′ W. long. and 51° 40′ N. lat.

BAMPTON is alfo the name of a market-town in Devonfhire, twenty miles north of Exeter, in 3° 40′ W. long. and 51° 5′ N. lat.

BAN, or BANN. See BANN.

BAN, in commerce, a fort of fmooth, fine muflin, which the Englifh import from the E. Indies. The piece is almoft a yard broad, and runs about twenty yards and a half.

BANBURY, a large borough-town in Oxfordfhire, twenty miles north of Oxford, in 1° 20′ W. long. and 52° 5′ N. lat.

BANC, or BENCH, in law, denotes a tribunal, or judgement-feat: Hence, king's-banc is the fame with the court of king's-bench, and common banc with that of common pleas. See KING'S BENCH and COMMON PLEAS.

BANCA, an ifland of the E. Indies, feparated from the fouth-eaft part of that of Sumatra by a very narrow channel, in 105° E. long. and 3° S. lat.

BANCALIS, a fea-port town on the eaft coaft of Sumatra, in 99° E. long. and 2° N. lat. It is a Dutch fettlement.

BANCOCK, a city of the kingdom of Siam, in 101° E. long. and 13° 30′ N. lat.

BAND, in a general fenfe, fome fmall, narrow ligament, wherewith any thing is bound, tied, or faftened.

BAND, in architecture, a general name for any flat, low member, or moulding, that is broad, but not very deep.

BAND *of foldiers*, in military affairs, thofe who fight under the fame flag or enfign.

Trained BANDS. See TRAINED *bands*.

BAND *of penfioners* are a company of 120 gentlemen, who receive a yearly allowance of a hundred pounds for attending on his majefty on folemn occafions.

BAND is alfo the denomination of a military order in Spain, inftituted by Alphonfus XI. king of Caftile, for the younger fons of the nobility; who, before their admiffion, muft ferve ten years, at leaft, either

in the army, or at court; and are bound to take up arms for the catholic faith againſt the infidels.

BAND, in ſurgery, a fillet, ſwath, or piece of linen cloth, wherewith either to cover or ſurround certain parts that ſtand in need of aſſiſtance; and is, in this ſenſe, the ſame with what is otherwiſe called a *roller*.

BANDA, or LANTOR, the chief of the Banda iſlands in the E. Indies, where nutmegs grow, in 128° E. long. and 4° 30′ S lat.

BANDAGE, in ſurgery, a fillet, roller, or ſwath, uſed in dreſſing and binding up wounds, reſtraining dangerous hæmorrhages, and in joining fractured and diſlocated bones. See SURGERY.

BANDALEER, or BANDELEER, in military affairs, a large leathern belt, thrown over the right ſhoulder, and hanging under the left arm; worn by the ancient muſqueteers, both for the ſuſtaining of their fire-arms, and for the carriage of their muſquet-charges, which being put up in little wooden caſes, coated with leather, were hung, to the number of twelve, to each bandeleer.

BANDELET, or BANDLET, in architecture, any little band, or flat moulding, as that which crowns the Doric architrave.

BANDER-ABASSI, in geography. See the article GOMBRON.

BANDER-CONGO, a ſea-port town on the eaſtern ſide of the Perſian gulf: E. long. 54° 50′, and N. lat. 27°.

BANDERET, a general, or one of the commanders in chief of the forces.

This appellation is given to the principal commanders of the troops of the canton of Bern in Switzerland, where there are four banderets, who command all the forces of that canton.

BANDEROLL, a little flag, in form of a guidon, extended more in length than breadth, uſed to be hung out on the maſts of veſſels, &c.

BANDITTI, a term peculiarly denoting companies of highwaymen, common in Italy and France; but ſometimes alſo uſed, in a more general ſenſe, for robbers, pirates, out-lawed perſons, ruffians, &c.

BANDO, the ſame with Aſmer. See ASMER.

BANDORA, the capital of the iſland of Salſet, or Conorin, on the weſt coaſt of the Hither India: E. long. 72° 30′, and N. lat. 19°.

BANDORA is alſo the name of an ancient muſical inſtrument, with ſtrings, reſembling a lute. See LUTE.

BANGLE *ears*, an imperfection in a horſe, remedied in the following manner. Place his ears in ſuch a manner as you would have them ſtand; bind them with two little boards ſo faſt that they cannot ſtir, and then clip away all the empty wrinkled ſkin cloſe by the head.

BANDY-LEGGED *perſons* are ſuch whoſe feet are diſtorted, turning either inward or outward on either ſide.

BANGOR, a city of Carnarvonſhire, in North Wales: W. long. 4° 15′, and N. lat. 53° 20′.

It is a biſhop's ſee, and ſituated on the ſea-ſide, about 30 miles weſt of St Aſaph.

BANGUE, or BEND. See BEND.

BANIALUCH, or BAGNALUCH, a city of European Turky, the capital of Boſnia, upon the frontiers of Dalmatia, near the river Setina: E. long. 18° 20′, N. lat. 44° 20′.

BANIANA, a city of India, upon the road from Surat to Agra.

BANIANS, a religious ſect in the empire of the Mogul, who believe a metempſychoſis; and will therefore eat no living creature, nor kill even noxious animals; but endeavour to releaſe them, when in the hands of others.

BANJAR, a river in the iſland of Borneo, in the mouth of which is a floating iſland, where the Eaſt-India company have a factory.

BANILLA, or VANILLA. See VANILLA.

BANISHMENT, a kind of puniſhment, whereby the guilty perſon is obliged to leave the realm.

BANK, in commerce, a common repoſitory, where many perſons agree to keep their money, to be always ready at their call or direction; or certain ſocieties or communities, who take the charge of other peoples money, either to improve it, or to keep it ſecure.

There are banks of various kinds, and different in the nature of their conſtitutions and eſtabliſhments: Some are inſtituted wholly on the public account, and put under the direction of the magiſtrates, as the famous bank of Amſterdam, where the money depoſited therein ſhall be always kept for the uſe of the proprietors, and ſhall never be let out for profit or advantage.

Payments made by aſſignments upon this bank, are valued from 3 to 6 *per cent* above the payment of the money in ſpecie, ariſing from an opinion that the proprietors entertain of the equity of its adminiſtration; for judging themſelves ſecure, that their money lies always ready at hand, they ſeldom draw out large ſums, but make their mutual payments by transferring the ſums from one man's account to another.

A ſecond ſort of bank, is ſuch as conſiſts of a company of monied men, who being duly eſtabliſhed, and incorporated by the laws of their country, agree to depoſite a conſiderable fund, or joint ſtock, to be employed for the uſe of the ſociety; as lending money upon good ſecurity, buying and ſelling bullion, gold and ſilver, diſcounting bills of exchange, &c.

A third ſort, is the banks of private men, or partnerſhips, who deal in the ſame way as the former, upon their own ſingle ſtock or credit. There are public banks eſtabliſhed in moſt of the trading cities of Europe, as in Venice, London, Paris, Amſterdam, Hamburgh, &c. The bank of Venice is the moſt ancient. It is eſtabliſhed by a ſolemn edict of the commonwealth, which enacts, That all payments of wholeſale merchandiſe, and letters of exchange, ſhall be in bank-notes; that all debtors ſhall be obliged to carry their money to the bank, and all creditors receive their money from the bank; ſo that payments are performed by a ſimple transfer from the one perſon to the other. In matters of retail, effective payments are ſometimes made, which do not diminiſh, but rather augment

augment the ſtock, by reaſon of the liberty of withdrawing their money at pleaſure, *&c.*

BANKAFALET, a game at cards, which being cut into as many heaps as there are players, every man lays as much money on his own card as he pleaſes; and the dealer wins or looſes as many as his card is ſuperior or inferior to thoſe of the other gameſters.

The beſt card is the ace of diamonds; the next to it, the ace of hearts; then the ace of clubs; and, laſtly, the ace of ſpades: And ſo of the reſt of theſe ſuits in order, according to their degree.

The cheat lies in ſecuring an ace, or any other ſure winning card; which are ſomehow marked, that the ſharper may know them.

BANKER, a perſon who traffics and negociates in money; who receives and remits money from place to place by commiſſion from correſpondents, or by means of bills or letters of exchange.

BANKISH, a province of the Mogul's dominions, in the north part of the Hither India, lying ſouth weſt of the province of Caſſimere.

Commiſſion of BANKRUPTCY. See COMMISSION.

BANN, or BAN, in the feudal law, a ſolemn proclamation or publication of any thing. Hence the cuſtom of aſking, or bans, before marriage. See MARRIAGE.

BANN, in military affairs, a proclamation made in the army by beat of drum, ſound of trumpet, *&c.* requiring the ſtrict obſervance of diſcipline, either for the declaring a new officer, or puniſhing an offender.

BANN *of the empire*, an imperial proſcription, being a judicial puniſhment, wherewith ſuch as are acceſſary to diſturbing the public peace are judged unworthy of the immunities and protection of the empire, and are out-lawed or baniſhed, *&c.*

BANNAGHER, a town of Ireland, in the king's county, and province of Leinſter, ſituated on the river Shannon, 8° W. long. and 53° 10′ N. lat.

BANNER denotes either a ſquare flag, or the principal ſtandard belonging to a prince.

BANNERET, an ancient order of knights, or feudal lords, who, poſſeſſing ſeveral large fees, led their vaſſals to battle under their own flag, when ſummoned thereto by the king.

BANNISTERIA, in botany, a genus of the decandria trigynia claſs. The calix is divided into 5 parts, with a nectarium at the baſe of each; the petals are roundiſh and unguiculated; the capſule contains 3 membranaceous alated ſeeds. The ſpecies are 7, all natives of America.

BANNIMUS, the form of expulſion of any member from the univerſity of Oxford, by affixing the ſentence up in ſome public place, as a denunciation of it.

BANNOCK, a kind of oat-cake, baked in the embers, or on a ſtone placed before the fire: It is common in the northern parts of this kingdom.

BANNUM, in law, ſignifies the utmoſt bounds of a manor or town.

BANQUET, a feaſt or entertainment, where people regale themſelves with pleaſant foods, or fruits. It ſignifies alſo a little bank, or raiſed way.

BANQUET, in the menage, that ſmall part of the branch of a bridle that is under the eye, which being rounded like a ſmall rod, gathers and joins the extremities of the bitt to the branch, and that in ſuch a manner, that the banquet is not ſeen, but covered by the cope, or that part of the bitt that is next the branch.

BANQUET-*line*, an imaginary line drawn, in making a bitt, along the banquet, and prolonged up or down, to adjuſt the deſigned force or weakneſs of the branch, in order to make it ſtiff or eaſy.

BANQUET, or BANQUETTE, in fortification, a little foot-bank, or elevation of earth, forming a path, which runs along the inſide of a parapet, upon which the muſqueteers get up, in order to diſcover the counterſcarp, or to fire on the enemy in the moat, or in the covert-way.

BANSTICLE, in ichthyology. See GASTEROSTEUS.

BANTAM, the capital of a large kingdom, and a port-town of great trade, ſituated on the north-weſt coaſt of the iſland of Java, in 105° E. long. and 6° 30′ S. lat.

BANTAM-WORK, a kind of painted or carved work, reſembling that of Japan, only more gaudy.

BANTON, in geography, one of the Philippine iſlands.

BANTRY, a town of Ireland, ſituated on a bay of the ſame name, in the county of Cork, and province of Munſter, in 9° 20′ W. long. and 51° 30′ N. lat.

BANZA, a city of Africa, the capital of the kingdom of Congo.

BAPAUME, a fortified town of the French Netherlands, about 12 miles ſouth-eaſt of Arras, in 3° E. long. and 50° 10′ N. lat.

BAPTISM, in matters of religion, a ſacrament, by which a perſon is initiated into the Chriſtian church. See RELIGION.

BAPTISM, in the ſea-language, a ceremony in long voyages on board merchant-ſhips, practiſed both on perſons and veſſels who paſs the tropic or line for the firſt time. The baptizing the veſſel is ſimple, and conſiſts only in waſhing them throughout with ſea-water; that of the paſſengers is more myſterious. The oldeſt of the crew, that has paſt the tropic or line, comes with his face blacked, a grotesque cap on his head, and ſome ſea-book in his hand, followed by the reſt of the ſea-men dreſſed like himſelf, each having ſome kitchen-utenſil in his hand, with drums beating. He places himſelf on a ſeat on the deck, at the foot of the main maſt. At the tribunal of this mock magiſtrate, each paſſenger not yet initiated, ſwears he will take care the ſame ceremony be obſerved, whenever he is in the like circumſtances: Then by giving a little money by way of gratification, he is diſcharged with a little ſprinkling of water, otherwiſe he is heartily drenched with ſtreams of water poured upon him; and the ſhip-boys are incloſed in a cage, and ducked at diſcretion.

The ſeamen, on the baptizing a ſhip, pretend to a right of cutting off the beak-head, unleſs redeemed by the captain.

BAPTISMAL, something belonging to baptism; thus, we say, *baptismal vow*, *fonts*, *presents*, &c.

BAPTISTS, in church-history, the name by which the Anabaptists love to distinguish themselves. See ANABAPTISTS.

BAPTISTERY, in ecclesiastical writers, a place in which the ceremony of baptism is performed. In the ancient church, it was one of the exedræ, or buildings, distinct from the church itself, and consisted of a porch or anti-room, where the persons to be baptized made their confession of faith; and an inner room where the ceremony of baptism was performed.

BAR, in a general sense, denotes a slender piece of wood, or iron, for keeping things close together.

BAR, in courts of justice, an inclosure made with a strong partition of timber, where the council are placed to plead causes. It is also applied to the benches where the lawyers or advocates are seated, because anciently there was a bar to separate the pleaders from the attorneys and others. Hence our lawyers, who are called to the bar, or licensed to plead, are termed baristers, an appellation equivalent to licentiate in other countries.

BAR, in law, a plea of a defendant, which is said to be sufficient to destroy the plaintiff's action.

BAR, in heraldry, an ordinary in form of the fess, but much less.

It differs from the fess only in its narrowness; and in this, that the bar may be placed in any part of the field, whereas the fess is confined to a single place. See Plate LI. fig. 4.

Bar-gemel, that is a double bar, called by the French *jumelles*, and by the Latin writers *jugariæ fasciolæ*, and *justitiæ bijuges*, is a diminutive of the fess. See Plate LI. fig. 5.

BAR, in the menage, the highest part of that place of a horse's mouth, situated between the grinders and tushes; so that the part of the mouth which lies under and at the side of the bars, retains the name of the gum. A horse with sensible bars has a fine light mouth, with an even and firm appui. See APPUI.

To BAR *a vein*, in farriery, is an operation performed upon the veins of the legs of a horse and other parts, with intent to stop the malignant humours. It is done by opening the skin above it, disengaging it, and tying it both above and below, and striking between the two ligatures.

BAR, in music, a stroke drawn perpendicularly across the lines of a piece of music, including between each two a certain quantity or measure of time, which is various as the time of the music is either triple or common. In common time, between each two bars is included the measure of four crotchets; in triple, three. The principal use of bars is to regulate the beating of time, in a concert. See TIME and MEASURE.

BAR, in hydrography, denotes a bank of sand, or other matter, whereby the mouth of a river is in a manner choaked up.

The term bar is also used for the strong beam wherewith the entrance of an harbour is secured: This is more commonly called boom.

BAR, BARRA, in commerce. See BARRA.

BAR, or BAR-LE-DUC, in geography, a duchy belonging to France, lying north-west of Lorrain, on both sides the river Maese, whereof Bar-le-duc is the principal town; in 5° 15′ E. long. and 48° 40′ N. lat.

BAR is also a town of Podolia, in Poland; situated in 28° E. long. and 48° 20′ N. lat.

BAR is also the name of two towns in France; the one in Champaign, upon the Aube; and the other in Burgundy, upon the Seine.

BARABINSKOI, a country of Tartary, tributary to the Muscovites.

BAR-MASTER, among miners, the person who keeps the gage, or dish, for measuring the ore.

BAR-SHOT. See SHOT.

BARACKS, or BARRACKS. See BARRACKS.

BARACOA, a town on the north-east part of the island of Cuba in North America, in 76° W. long. and 21° N. lat.

BARALIPTON, among logicians, a term denoting the first indirect mode of the first figure of syllogism. A syllogism in baralipton, is when the two first propositions are general, and the third particular, the middle term being the subject in the first proposition, and the predicate in the second.

BARALLOTS, in church-history, a sect of heretics at Bologna in Italy, who had all things in common, even their wives and children.

Their facility in complying with all manner of debauchery, made them get the name *obedientes*, compliers.

BARANCA, a port-town of Terra Firma, in South America; situated about 30 miles up the river Grande, in 75° 30′ W. long. and 11° N. lat.

BARANGI, officers among the Greeks of the lower empire. Cujas calls them in Latin *protectores*, and others give them the name of *securigeri*. It was their business to keep the keys of the city-gates, where the emperor resided.

BARANWAHR, a town of Lower Hungary, not far from the Danube, in 20° E. long. and 46° 20′ N. lat.

BARAPICKLET, bread made of fine flour, and kneaded up with barm, which makes it very light and spungy. Its form is round, about a hand-breadth.

BARATHRUM, in antiquity, a deep dark pit at Athens, into which condemned persons were cast headlong. It had sharp spikes at the top, that no man might escape out, and others at the bottom to pierce and torment such as were cast in.

BARB, or BARBE, in commerce. See BARBE.

BARBA, in botany, a word often used in composition with some other, to form the trivial names of several plants, as *barba jovis*, *barba capræ*, &c.

BARBACAN, or BARBICAN, an outer defence, or fortification to a city or castle, used especially as a fence to the city, or walls; also, an aperture made in the wall of a fortress, to fire through upon the enemy.

BARBACAN is also used to denote a fort at the entrance of a bridge, or the outlet of a city, having a double wall with towers.

BARBALIA, in botany, a genus of the didynamia angiospermia. The calix consists of four divisions; the capsule

capſule is quadrangular, with two elaſtic valves, and two ſeeds. There are ſix ſpecies, none of them natives of Britain.

BARBACAN, in architecture, a canal, or opening left in the wall, for water to come in and go out, when buildings are erected in places liable to be overflowed, or to drain off the water from a terras, or the like.

BARBADOES, one of the Britiſh Caribbee Iſlands, lying eaſtward of all the reſt, in 59° 30′ W. long. and 13° N. lat. being only 25 miles in length, and about 15 in breadth.

BARBADOES-TAR, a mineral fluid of the nature of the thicker fluid bituinens, of a nauſeous, bitteriſh taſte, very ſtrong and diſagreeable ſmell, found in many parts of America trickling down the ſides of the mountains, and ſometimes floating on the ſurface of the waters. It has been greatly recommended in coughs, and other diſorders of the breaſt and lungs.

BARBANCON, a principality of Hainault.

BARBARA, among logicians, the firſt mode of the firſt figure of ſyllogiſms.

A ſyllogiſm in barbara, is one whereof all the propoſitions are univerſal and affirmative; the middle term being the ſubject of the firſt propoſition, and attribute in the ſecond. For example,

BAR. Every wicked man is miſerable;
BA. All tyrants are wicked men;
RA. Therefore all tyrants are miſerable.

BARBARIAN, a name given by the ancient Greeks and Romans to all who were not of their own country, or were not initiated in their language, manners, and cuſtoms.

In this ſenſe the word ſignified with them no more than foreigner; not ſignifying, as among us, a wild, rude, or uncivilized perſon.

BARBARISM, in a general ſenſe, a rudeneſs of language or behaviour.

BARBARISM, in grammar, an offence againſt the purity of ſtyle or language; or an ungrammatical way of ſpeaking or writing, or contrary to the true idiom of any particular language.

BARBARY, a large tract of Africa, extending along the Mediterranean, from 2° W. long. to 30° E. long. that is, from the river Mulvia, which ſeparates it from Morocco, to Egypt.

It comprehends the countries of Algers, Tunis, Tripoli, and Barca.

BARBASOTE, a ſea-port of Africa in the kingdom of Fez, at a little diſtance from Ceuta. See CEUTA.

BARBE, in commerce, a barbary horſe, greatly eſteemed for its beauty, ſtrength, and ſwiftneſs. Barbes are commonly of a ſlim ſhape, and have very thin legs; they retain their vigour to the laſt, and are therefore much prized for ſtallions. They are uſed both for the ſaddle and the coach.

BARBE, in the military art: To fire in barbe, means to fire the cannon over the parapet, inſtead of firing through the embraſſures; in which caſe the parapet muſt not be above three feet and a half high.

BARBE, or BARDE, is an old word, denoting the armour of the horſes of the ancient knights and ſoldiers, who were accoutred at all points. It is ſaid to be an armour of iron and leather, wherewith the neck, breaſt, and ſhoulders of the horſe were covered.

BARBED, in a general ſenſe, bearded like a fiſh-hook, ſet with barbs; alſo ſhaved or trimmed.

BARBED, and CRESTED, in heraldry, an appellation given to the combs and gills of a cock, when particularized for being of a different tincture from the body.

A barbed croſs, is a croſs, the extremities whereof are like the barbed irons uſed for ſtriking of fiſh. See Plate LI. fig. 6.

BARBELICOTÆ, in church-hiſtory, a ſect of gnoſtics, who affirmed that an immortal Eon had commerce with a virgin called Barbelath, to whom he granted ſucceſſively the gift of prophecy, incorruptibility, and eternal life.

BARBER, one who makes a trade of ſhaving or trimming the beards of other men for money.

BARBERINO, a town of Tuſcany in Italy, ſituated upon the river Siera, in 11° E. long. and 44° 5′ N. lat.

BARBERRY, in botany. See BERBERIS.

BARBICAN, or BARBACAN. See BARBACAN.

BARBLE, or BARBEL. See BARBEL.

BARBLES, or BARBS, in farriery, the knots or ſuperfluous fleſh, that grow up in the channels of a horſe's mouth; that is, in the intervals that ſeparate the bars, and lie under the tongue.

BARBOTINE, a ſeed called *ſemen ſantonicum, & ſemen contra vermes;* in Engliſh, worm ſeed. See WORM-SEED.

BARBORA, a maritime city of Africa, in the kingdom of Adel, upon the ſtreights of Babelmandel.

BARBUDA, one of the Britiſh Caribbee Iſlands, about 20 miles long, and 12 broad, in 61° W. long. and 18° N. lat.

BARBUS, in ichthyology. See CYPRINUS.

BARBUSINSKOI, a city of Aſia, in the Ruſſian empire, ſituated upon the eaſtern bank of the lake Baikal.

BARBY, a town of Upper Saxony, in Germany, upon the Elbe.

BARBYLA, in botany. See PRUNUS.

BARCA, a country lying on the Mediterranean, between Tripoli and Egypt; a barren deſart for the moſt part.

BARCALON, an apellation given to the prime miniſter of the king of Siam. The barcalon has in his department every thing relating to commerce, both at home and abroad. He is likewiſe ſuperintendant of the king's magazines.

BARCELONA, the chief city of Catalonia, in Spain. It is ſituated in a large plain along the ſhore of the Mediterranean; being divided into the new and old town, ſeparated from each other by a wall and ditch: 2° E. long. and 41° 20′ N. lat.

BARCELONETA, a town of Piedmont, now ſubject to France: 6° 40′ E. long. and 44° 35′ N. lat.

BARCELOR, or BASSELOR, a port-town on the coaſt of Malabar, in 74° 15′ E. long. and 13° 30′ N. lat.

BARCELOS, a town of the province of Entre-Minho-Duro, in Portugal, about 30 miles north of Porto, in 9° 15′ W. long. and 41° 20′ N. lat.

BARD, a poet among the ancient Gauls and Britons, who celebrated the praiſes of heroes, with a view to inculcate virtue, and ſometimes to terminate a difference between two armies at the point of engagement. It is dſputed wherein the bards differed from the druids: Some pretend that theſe were the prieſts and philoſophers of the nation, and that thoſe were only the poets and hiſtorians; but it is more probable that druid was a general word, comprehending the prieſts, the judges, the inſtructors of youth, and the bards or poets.

BARDANA, in botany. See ARCTIUM.

BARDED, in heraldry, the ſame with capariſoned.

BARDELLE, in the menage, a ſaddle made in the form of a great ſaddle, but only of cloth ſtuffed with ſtraw, and tied tight down with packthread, without either leather, wood, or iron. In Italy they trot their colts with ſuch ſaddles.

BARDESANISTS, in church-hiſtory, Chriſtian heretics of the ſecond century, who maintained that the devil was a ſelf-exiſtent independent being; that Jeſus Chriſt was not born of a woman, but brought his body with him from heaven; and denied the reſurrection of the body.

BARDEWICK, a town in Lower Saxony in Germany, about ſeven miles north of Lunenburg. It is ſubject to the elector of Hanover, and ſituated in 10° 6′ E. long. and 53° 40′ N. lat.

BARDS, BARDI. See BARD.

BARDS, in the art of cookery, broad ſlices of bacon, with which pullets, capons, pigeons, &c. are ſometimes covered, before they are roaſted, baked, or otherwiſe dreſſed.

BARDT, a port-town of Pomerania, in Germany; it is ſubject to Sweden, and ſituated in 13° 20′ E. long. and 54° 20′ N. lat.

BAREITH, a town of Franconia in Germany, &c. in the margraviate of Culbach; in 12° 20′ E. long. and 50° N. lat.

BARENTON, a town of lower Normandy in France.

BAR-FEE, a fee of twenty pence which every priſoner acquitted of felony pays to the goaler.

BARFLEUR, a town and cape of Normandy, in France, about 12 miles eaſt of Cherburg; in 1° 15′ W. and 49° 47′. N. lat.

BARGE, in naval affairs, a boat of ſtate and pleaſure, adorned with various ornaments, having bales and tilts, and ſeats covered with cuſhions and carpets, and benches for many oars; as the lord-mayor's barge, a company's barge, an admiral's barge, &c. It is alſo the name of a flat-bottomed veſſel employed for carrying goods in a navigable river; as thoſe upon the river Thames, called *weſt-country barges*.

BARGE, in ornithology. See SCOLOPAX.

BARGE-*couples*, in architecture, a beam mortiſed into another, to ſtrengthen the building.

BARGE-*courſe*, with bricklayers, a term uſed for that part of the tiling which projects over without the principal rafters, in all ſorts of buildings, where there is either a gable or a kirkin-head. See GABLE and HEAD.

BARGEMONT. a town of Provence in France, in the dioceſe of Frejus.

BARILLIA, a kind of Spaniſh pot-aſh, uſed in the glaſs-trade.

BARING *of trees*, in agriculture, the taking away ſome of the earth about the roots, that the winter-rain and ſnow-water may penetrate further into the roots. This is frequently practiſed in the autumn.

BARJOLS, a town of Provence in France, in 6° 50′ E. long. and 43° 36′ N. lat.

BARIPICNI, or SUONI BARIPICNI, in muſic, ſignify in general any low, grave, or deep ſound.

BARK, in the anatomy of plants, the exterior part of trees, correſponding to the ſkin of an animal. See AGRICULTURE, p. 43.

BARK, or JESUIT'S BARK, is a name given by way of eminence to the quinquina. See QUINQUINA.

BARK, in navigation, a little veſſel with two or three triangular ſails; but, according to Guillet, it is a veſſel with three maſts, *viz.* a main-maſt, fore-maſt, and mizen-maſt. It carries about two hundred tons.

BARKAN, a town of Hungary, remarkable for two victories which the Chriſtians obtained there over the Turks, the one in 1664, and the other in 1683.

BARKARY, a tan-houſe, or place for keeping bark.

BARK-*binding*, a diſtemper incident to trees, cured by ſlitting the bark, or cutting along the grain.

BARK-*galling*, is when the trees are galled with thorns, &c. It is cured by binding clay on the galled places.

BARK-*longue*, or BARCA *longa*, a ſmall low ſharp-built, but very long veſſel without a deck. It goes with ſails and oars, and is very common in Spain.

BARKHAMSTEAD, a market-town in the weſt part of Hertfordſhire, about eighteen miles weſt of Hertford, in 4′ W. long. and 51° 40′ N. lat.

BARKING, a fiſhing town of Eſſex, ſituated on the river Thames, about eight miles eaſt of London.

BARKING *of trees*, the peeling off the rind or bark. This muſt be done, in our climate, in the month of May, becauſe at that time the ſap of the tree ſeparates the bark from the wood. It would be very difficult to perform it at any other time of the year, unleſs the ſeaſon was extremely wet and rainy, for heat and dryneſs are a very great hinderance to it.

BARKLEY, a market-town of Glouceſterſhire, about fifteen miles ſouth-weſt of Glouceſter, in 2° 35′ W. lon. and 51° 40′ N. lat.

BARKWAY, a market-town in Hertfordſhire, under the meridian of London, and fifteen miles ſouth of Cambridge.

BARLEDUC, the capital of the duchy of Bar. See BAR.

BARLEMONT, a town of Hainault, in the French Netherlands, ſituated on the river Sambre, about fifteen miles ſouth of Mons. in 3° 40′ E. long. and 50° 10′ N. lat.

BARLETTA, a port-town of Barri, in the kingdom of Naples, ſituated on the gulf of Venice, twenty-two miles weſt of Barri, in 17° E. long. and 41° N. lat.

BARLEY, in botany. See HORDEUM.

BARLEY-*corn*, the leaſt of our long-meaſures, being the third of an inch.

BARLOVENTO *Iſles*, the ſame with the Caribbees.

BARM, the ſame with yeſt. See YEST.

BARNABITES, a religious order, founded in the ſixteenth century by three Italian gentlemen, who had been adviſed by a famous preacher of thoſe days to read carefully the epiſtles of St Paul. Hence they were called *clerks of St Paul*, and *Barnabites*, becauſe they performed their firſt exerciſe in a church of St Barnabas at Milan. Their habit is black, and their office is to inſtruct, cathechiſe, and ſerve in miſſion.

BARNACLE, in ornithology, a ſpecies of gooſe. See ANAS.

BARNACLES, in farriery, an inſtrument compoſed of two branches joined at one end with a hinge, to put upon horſes noſes when they will not ſtand quietly to be ſhod, blooded, or dreſſed.

BARNARD-CASTLE, a town of the biſhopric of Durham, in 1° 3′ W. long. and 54° 26′ N. lat.

BARNET, a market-town of Middleſex (part of it in Hertfordſhire) ten miles north-weſt of London, in 10′ W. long. and 51° 42′ N. lat.

BARNSTABLE, a port-town of Devonſhire, ſituated on the river Tan, about thirty miles north of Exeter, in W. long. 4° 10′, and 51° 42′ N. lat. It ſends two members to parliament.

BAROCHE, a port-town of the hither India, in the province of Cambaya; ſituated ſixty miles north of Surat, in 72° 5′ E. long. and 22° 15′ N. lat.

BAROCO, in logic, a term given to the fourth mode of the ſecond figure of ſyllogiſms. A ſyllogiſm in baroco has the firſt propoſition univerſal and affirmative, but the ſecond and third particular and negative, and the middle term is the predicate in the two firſt propoſitions. For example,

Nullus homo non eſt bipes:
Non omne animal eſt bipes:
Non omne animal eſt homo.

BAROMETER, a machine for meaſuring the weight of the atmoſphere, and the variations therein, in order to determine the changes of the weather. See PNEUMATICS.

BARON, a degree of nobility next below a viſcount, and above a baronet. It is probable that formerly all thoſe were barons who had lordſhips with courts-baron, and ſoon after the conqueſt all ſuch ſat in the houſe of peers; but they being very numerous, it grew an order and cuſtom, that none ſhould ſit but ſuch as the king thought fit to call up by writ, which ran *pro hac vice tantum*. This ſtate of nobility being very precarious, they at length obtained of the king letters patent; and theſe were called *barons by patent*, or *creation*, the only way now in uſe of making barons, unleſs when the ſon of a lord, in his anceſtor's life-time, is ſummoned by a writ.

On ſolemn occaſions, barons wear a coronet, repreſented in Plate LI. fig. 19.

BARON *by tenure*, one who held certain territories of the king, who ſtill retained the tenure in chief to himſelf.

BARONS *of the exchequer*, the four judges to whom the adminiſtration of juſtice is committed, in cauſes between the king and his ſubjects, relating to matters concerning the revenue. They were formerly barons of the realm, but of late are generally perſons learned in the laws. Their office is alſo to look into the accounts of the king, for which reaſon they have auditors under them. See AUDITOR.

BARONS *of the cinque-ports* are members of the houſe of commons, elected by the five ports, two for each port. See the article CINQUE-PORTS.

BARON *and* FEME, in our law, a term uſed for the huſband in relation to his wife, who is called *feme*; and they are deemed but one perſon; ſo that a wife cannot be witneſs for or againſt her huſband, nor he for or againſt his wife, except in caſes of high treaſon.

BARON *and* FEME, in heraldry, is when the coats of arms of a man and his wife are borne per pale in the ſame eſcutcheon, the man's being always on the dexter ſide, and the woman's on the ſiniſter; but here the woman is ſuppoſed not an heireſs, for then her coat muſt be borne by the huſband on an eſchutcheon of pretence. See PALE and ESCUTCHEON *of pretence*.

Prendre de BARON. See PRENDRE.

BARONET, a modern degree of honour, next to a baron, created by K. James I. in order to propagate a plantation in Ulſter in Ireland, for which purpoſe each of them was to maintain thirty ſoldiers in Ireland, for three years, after the rate of eight pence ſterling per day to each ſoldier. The honour is hereditary, and they have the precedence of all knights, except thoſe of the garter, bannerets, and privy-counſellors. They are ſtyled *baronets* in all writs, and the addition of *Sir* is attributed to them, as the title of *Lady* is to their wives. No honour is be created between barons and baronets.

BARONY, the honour and territory which gives title to a baron, whether he be a layman or a biſhop.

BAROSCOPE, the ſame with barometer. See BAROMETER

BARR, or BAR. See BAR.

BARR-*dice*, falſe dice, ſo contrived as not readily to turn up certain ſides.

BARRA, in commerce, a long-meaſure uſed in Portugal and ſome parts of Spain, to meaſure woolen cloths, linen cloths, and ſerges. There are three ſorts, the barra of Valencia, 13 of which make $12\frac{7}{8}$ yards Engliſh meaſure; the barra of Caſtile, 7 of which make $6\frac{1}{4}$ yards; and the barra of Aragon, 3 of which make $2\frac{4}{7}$ yards Engliſh.

BARRACAN, in commerce, a ſort of ſtuff, not diapered, ſomething like camblet, but of a coarſer grain. It is uſed to make cloaks, ſurtouts, and ſuch other garments, to keep off the rain.

BARRACKS, or BARACKS, places for ſoldiers to lodge in, eſpecially in garriſons.

BARRATOR, in law, a common mover or maintainer of ſuits and quarrels, either in courts, or elſewhere in the country. A man cannot be adjudged a barrator for bringing any number of ſuits in his own right, though they are vexatious. Barrators are puniſhed by fine and impriſonment.

BAR-

BARRATRY, in law, ſignifies the fomenting quarrels and law-ſuits.

BARRATRY, in a ſhip-maſter, is his cheating the owners. If goods delivered on ſhip-board, are embezzled, all the mariners ought to contribute to the ſatisfaction of the party that loſt his goods, by the maritime law; and the cauſe is to be tried in the admiralty. In a caſe, where a ſhip was inſured againſt the barratry of the maſter, *&c.* and the jury found that the ſhip was loſt by the fraud and negligence of the maſter, the court agreed, that the fraud was barratry, though not named in the covenant; but that negligence was not.

BARREAUX-*Fort*, a fortreſs of Savoy, having Montmelian on the north, and Grenoble on the ſouth, ſituated in 5° 30′ E. long. and 45° N. lat.

BARREL, in commerce, a round veſſel, extending more in length than in breadth, made of wood, in form of a little tun. See TUN.

It ſerves for holding ſeveral ſorts of merchandize.

Barrel is alſo a meaſure of liquids. The Engliſh barrel, wine-meaſure, contains the eighth part of a tun, the fourth part of a pipe, and one half of a hogſhead; that is to ſay, it contains thirty-one gallons and a half: A barrel, beer-meaſure, contains thirty-ſix gallons; and, ale-meaſure, thirty-two gallons. The barrel of beer, vinegar, or liquor preparing for vinegar, ought to contain thirty-four gallons, according to the ſtandard of the ale quart.

BARREL alſo denotes a certain weight of ſeveral merchandizes, which differs according to the ſeveral commodities: A barrel of Eſſex butter weighs one hundred and ſix pounds; and of Suffolk butter, two hunhundred and fifty-ſix pounds. The barrel of herrings ought to contain thirty-two gallons wine meaſure, which amount to about twenty-eight gallons old ſtandard, containing about a thouſand herrings. The barrel of ſalmon muſt contain forty-two gallons. The barrel of eels the ſame. The barrel of ſoap muſt weigh two hundred and fifty-ſix pounds.

BARREL, in mechanics, a term given by watch-makers to the cylinder about which the ſpring is wrapped: And by gun-ſmiths to the cylindrical tube of a gun, piſtol, *&c.* through which the ball is diſcharged.

BARREL, in anatomy, a pretty large cavity behind the tympanum of the ear, about four or five lines deep, and five or ſix wide.

Thundering BARRELS, in the military art, are filled with bombs, grenades, and other fire-works, to be rolled down a breach.

BARRENNESS, the ſame with ſterility. See STERILITY.

BARRERA, in botany, a genus of the pentandria pentagynia claſs. The calix has five diviſions, and the petals five, with long filiform claws. There is but one ſpecies, *viz.* the capenſis, a native of Æthiopia.

BARRI, a city of the kingdom of Naples, and capital of a province of the ſame name, ſituated on the gulf of Venice, in 17° 40′ E. long. and 40° 40′ N. lat.

BARRICADE, a warlike defence, conſiſting of empty barrels and ſuch like veſſels, filled with earth, ſtones, carts, trees cut down, againſt an enemy's ſhot, or aſſault; but generally trees cut with ſix faces, which are croſſed with battoons as long as a half-pike, bound about with iron at the feet.

BARRIER, in fortification, a kind of fence made at a paſſage, retrenchment, *&c.* to ſtop up the entry thereof, and is compoſed of great ſtakes, about four or five feet high, placed at the diſtance of eight or ten feet from one another, with tranſums, or over-thwart rafters, to ſtop either horſe or foot, that would enter or ruſh in with violence: In the middle is a moveable bar of wood, that opens and ſhuts at pleaſure. A barrier is commonly ſet up in a void ſpace, between the citadel and the town, in half moons, *&c.*

BARRIER has been alſo uſed to ſignify a martial exerciſe of armed men, fighting together with ſwords, within rails or bars, which incloſed them.

BARRING *a vein*, in farriery, an operation performed upon the veins of a horſe's legs, and other parts of his body, with intent to ſtop the courſe, and leſſen the quantity of the malignant humours that prevail there.

BARRISTER, in common law, a perſon qualified, and impowered to plead and defend the cauſe of clients, in the courts of juſtice. They are of two ſorts, the outward, or outer-barriſters, who, by their long ſtudy in and knowledge of the law, which muſt be for a term of ſeven years at leaſt, are called to public practice, and always plead without the bar.

The inner-barriſters are thoſe, who, becauſe they are either attorney, ſollicitor, ſerjeant, or council to the king, are allowed, out of reſpect, the privilege of pleading within the bar. But at the rolls, and ſome other inferior courts, all barriſters are admitted within the bar.

Barriſters, in the Engliſh laws, amount to the ſame with licentiates and advocates in other countries, and courts, where the civil, *&c.* laws obtain.

BARROW, in the ſalt-works, wicker-caſes, almoſt in the ſhape of a ſugar-loaf, wherein the ſalt is put to drain.

BARRULET, in heraldry, the fourth part of the bar, or the one half of the cloſſet: An uſual bearing in coat-armour.

BARRULY, in heraldry, is when the field is divided bar-ways, that is acroſs from ſide to ſide, into ſeveral parts. See Plate LI. fig. 7.

BARRY, in heraldry, is when an eſcutcheon is divided bar-ways, that is, acroſs from ſide to ſide, into an even number of partitions, conſiſting of two or more tinctures, interchangeably diſpoſed: It is to be expreſſed in the blazon by the word *barry*, and the number of pieces muſt be ſpecified; but if the diviſions be odd, the field muſt be firſt named, and the number of bars expreſſed.

BARRY-BENDY is when an eſcutcheon is divided evenly, bar and bend-ways, by lines drawn tranſverſe and diagonal, interchangeably varying the tinctures of which it conſiſts. See Plate LI. fig. 8.

BARRY-PILY is when a coat is divided by ſeveral lines drawn obliquely from ſide to ſide, where they form acute angles.

BARTER, or TRUCK, is the exchanging of one commodity

modity for another; in doing of which the price of one of the commodities, and an equivalent quantity of the other, muſt be found either by practice, or by the rule of three.

Queſt. 1. How many pounds of cotton, at 9 d. *per* lb. muſt be given in barter for 13 C. 3 Q. 14 lb. of pepper, at 2 l. 16 s. *per* C.?

Firſt, Find the price or value of the commodity whoſe quantity is given, as follows.

	C.	Q.	lb.		L.	s.
	13	3	14	at	2	16
2 l.	26					
16 s.	10	8				
2 Q.	1	8				
1 Q.		14				
14 lb.		7				
	L.38	17				

Secondly, Find how much cotton, at 9 d. *per* lb. 38 l. 17 s. will purchaſe, as under.

d. *lb.* *L.* *s.*
If 9 : 1 :: 38 17
20
777
12
9)9324(
C. *Q.*
Anſ. 1036 *lb.* = 9 1

If the above queſtion be wrought decimally, the operation may ſtand as follows:

C. *L.* *C.*
If 1 : 2.8 :: 13.875
2.8
111000
27750
lb. *C.* *Q.*
.0375)38.8500(1036 = 9 1 *Anſ.*
375...
1350
1125
2250
2250

The value or price of the goods received and delivered in barter being always equal, it is obvious, that the product of the quantities received and delivered, multiplied into their reſpective rates, will be equal.

Hence ariſes a rule which may be uſed with advantage in working ſeveral queſtions; namely, Multiply the given quantity and rate of the one commodity, and the product divided by the rate of the other commodity quotes the quantity ſought; or divided by the quantity quotes the rate.

Queſt. 2. How many yards of linen, at 4 s. *per* yard, ſhould I have in barter for 120 yards of velvet, at 15 s. 6 d.?

Yds. *Sixp.* *Sixp.* *Yds.*
120 × 31 = 3720, and 8)3720(459 *Anſ.*

BARTHOLOMEW, or *St* Bartholomew, one of the Caribbee iſlands, ſituated in 62° 5′ W. long. and 18° 6′ N. lat.

BARTON, a market-town in Lincolnſhire, ſituated on the ſouthern ſhore of the Humber, 30 miles ſouth-eaſt of York, in 15′ W. long. and 53° 40′ N. lat.

Barton is alſo uſed, in the weſt of England, for the demeſne lands of a manor; alſo for the manor-houſe; and in ſome parts for out-houſes, *&c.*

BARTSIA, in botany, a genus of the didynamia angioſpermia claſs. The calix has two coloured emarginated lobes; the corolla is leſs than the calix, and the ſuperior lip is longeſt; the capſule has two cells. The ſpecies are 4, of which the viſcoſa, or marſh eyebright cow-wheat, and the alpina, or mountain eyebright cow-wheat, are natives of Britain.

BARUA, a city of Abyſſinia, in Africa, the capital of the kingdom of Barnagaſſa.

BARULES, in church-hiſtory, certain heretics, who held that the Son of God had only a phantom of a body; that ſouls were created before the world, and that they lived all at one time.

BARUTH, an Indian meaſure, containing ſeventeen gantans: It ought to weigh about three pounds and an half Engliſh avoirdupois.

BARYTONUM, in the Italian muſic, the ſame with our baſs. See Bass.

BAS-RELIEF. See Basso-relievo.

BASALTES, in natural hiſtory, called alſo *coticula*, *lapis heraclius*, and *lapis lydius*, a kind of marble, of a very fine texture, of a deep gloſſy black, reſembling that of poliſhed ſteel, and mixed with no other colour, nor any extraneous matter. The moſt remarkable quality of this marble is its figure, being never found in ſtrata, like other marbles, but always ſtanding up in the form of regular angular columns, compoſed of a number of joints, one placed on and nicely fitted to another, as if formed by the hands of a ſkilful workman. It is remarkably hard and heavy, will not ſtrike fire with ſteel, and is a fine touch-ſtone. See Plate LI. fig. 20. The baſaltes was originally found in columns in Ethiopia, in fragments in the river Tmolus, and ſome other places; we now have it frequently, both in columns and ſmall pieces, in Spain, Ruſſia, Poland, near Dreſden, and in Sileſia; but the nobleſt ſtore in the world ſeems to be that called the *Giant's cauſeway*, in Ireland, where it riſes far up in the country, runs into the ſea, croſſes its bottom, and riſes again on the oppoſite land.

BASANUS, or Basanites, names uſed by ancient writers for the baſaltes.

BASARUCO, in commerce, a ſmall baſe coin in the Eaſt Indies, being made only of very bad tin. There are, however, two ſorts of this coin, a good and a bad; the bad is one ſixth in value lower than the good.

BASE, in geometry, the loweſt ſide of the perimeter of a figure: Thus, the baſe of a triangle may be ſaid of any of its ſides, but more properly of the loweſt, or that which is parallel to the horizon. In rectangled triangles, the baſe is properly that ſide oppoſite to the right angle.

BASE *of a ſolid figure*, the loweſt ſide, or that on which it ſtands.

BASE *of a conic ſection*, a right line in the hyperbola and parabola, ariſing from the common interſection of the ſecant plane, and the baſe of the cone.

Altern BASE. See ALTERN.

BASE, in architecture, is uſed for any body which bears another, but particularly for the lower part of a column and pedeſtal. See ARCHITECTURE.

BASE, in fortification, the exterior ſide of the polygon, or that imaginary line which is drawn from the flanked angle of a baſtion, to the angle oppoſite to it.

BASE, in gunnery, the leaſt ſort of ordnance, the diameter of whoſe bore is $1\frac{1}{4}$ inch, weight 200 pound, length 4 feet, load 5 pound, ſhot $1\frac{1}{4}$ pound wt. and diameter $1\frac{1}{8}$ inch.

BASE *line*, in perſpective, the common ſection of a picture, and the geometrical plane.

Diſtinct BASE, in optics. See FOCUS.

BASE *of the heart*, in anatomy, denotes its upper part.

BASE, or BASS, in muſic. See BASS.

BASE *point*, in heraldry. See POINT.

BASELLA, in botany, a genus of the pentandria trigynia claſs. It has no calix; the corolla has 6 diviſions; and there is but one ſeed in the capſule. The ſpecies are 3, *viz.* the rubra, alba, and lucida, all natives of India.

BASEMENT, in architecture, a baſe continued a conſiderable length, as round a houſe, room, *&c.* See ARCHITECTURE.

BASHAW, a Turkiſh governor of a province, city, or other diſtrict.

Baſhaws include beglerbegs, and ſometimes ſangiacbegs, though a diſtinction is ſometimes made, and the name *baſhaw* is appropriated to the middle ſort, or ſuch as have two enſigns or horſe-tails carried before them. Thoſe who have the honour of three tails, are called *beglerbegs*; and thoſe who have only one, *ſangiacbegs*.

The appellation *baſhaw* is given by way of courteſy to almoſt every perſon of any figure at the grand ſignior's court.

BASIENTO, a river of the kingdom of Naples, which riſes near Potenza in the Baſilicate, waters that province, and runs into the gulf of Tarento.

BASIGLOSSUS, or BASIOGLOSSUS. See BASIOGLOSSUM.

BASIL, in geography, a city and canton of Switzerland, near the confines of Alſace, ſituated on both ſides the river Rhine.

The city is large, populous, and fortified; being ſituated in 7° 40′ E. long. and 47° 40′ N. lat.

BASIL, in botany. See OCYMUM.

BASIL, among joiners, the ſloping edge of a chiſſel, or of the iron of a plane, to work on ſoft wood: They uſually make the baſil 12 degrees, and for hard wood 18; it being remarked, that the more acute the baſil is, the better the inſtrument cuts; and the more obtuſe, the ſtronger and fitter it is for ſervice.

Order of St BASIL, the moſt ancient of all the religious orders, was very famous in the eaſt. It paſſed into the weſt about the year 1057, and was held in great eſteem, eſpecially in Italy. As to their rules, the Italian monks of that order faſt every Friday in the year: They eat meat but three times a week, and then but once a-day: They work all together at certain hours of the day: Their habit is nearly like that of the Benedictines, and they wear a ſmall beard like the fathers of the miſſion.

BASILARE *os*, in anatomy, the ſame with *os ſphenoides*. See SPHENOIDES.

BASILIC, in ancient architecture, a term uſed for a large hall, or public place, with iſles, porticos, galleries, tribunals, *&c.* where princes ſat and adminiſtered juſtice in perſon.

BASILICA, in anatomy, the interior branch of the axillary vein, running the whole length of the arm.

BASILICATE, a province of the kingdom of Naples, having the Terra di Barri on the north, and the province of Calabria on the ſouth.

BASILICI, a denomination given in the Greek empire to thoſe who carried the emperor's orders and commands.

BASILICON, in pharmacy, an epithet for a great many compoſitions to be found in the ancient medicinal writers: But it more particularly denotes an officinal ointment, compoſed of wax, reſin, pitch, and oil of olives, from thence called *tetrupharmacum*. It is much uſed in wounds.

BASILICS, a body of the Roman laws, tranſlated into Greek. The baſilics comprehend the inſtitutes, digeſts, code, novels, and ſome edicts of Juſtinian and other emperors.

BASILICUS, in aſtronomy, *cor leonis*, a fixed ſtar of the firſt magnitude in the conſtellation Leo. See LEO.

BASILIDIANS, in church-hiſtory, a branch of gnoſtics, who maintained that Chriſt's body was only a phantom, and that Simon the Cyrenean ſuffered in his ſtead.

BASILIGOROD, a city of the Ruſſian empire, in Muſcovitiſh Tartary, ſituated upon the banks of the Wolga.

BASILISCUS, in zoology, the trivial name of a ſpecies of lacerta. See LACERTA.

BASILISK, in military affairs, a large piece of ordnance, being a 48-pounder, and weighing about 7200 pounds. Thoſe of the French were 10 feet long, and thoſe of the Dutch 15. The French do not caſt any more of that calibre.

BASINGSTOKE, a market-town of Hampſhire, about 16 miles north-eaſt of Wincheſter, in 1° 15′ W. lon. and 51° 20′ N. lat.

BASIOGLOSSUS, in anatomy, a muſcle ariſing from the baſe of the os hyoides.

BASIS, *baſe*, in geometry. See BASE.

Basis, among phyſicians, denotes the principal ingredients in compound medicines.

BASKET, a machine made of twigs interwoven together, in order to hold fruit, earth, &c. It denotes an uncertain quantity, as a baſket of medlars is two buſhels, of aſa fœtida from 20 to 50 pound weight.

Baskets *of earth*, in the military art, called by the French *corbeilles*, are ſmall baſkets uſed in ſieges, on the parapet of a trench, being filled with earth. They are about a foot and a half high, about a foot and a half diameter at the top, and 8 or 10 inches at bottom; ſo that being ſet together, there is a ſort of embraſſures left at their bottoms, through which the ſoldiers fire, without expoſing themſelves.

Basket-fish. See Asterias.

Basket-salt, that made from ſalt-ſprings, being purer, whiter, and compoſed of finer grains than the common brine-ſalt.

Basket-tenure, a tenure of lands by the ſervice of making the king's baſkets.

BASKIRI, a country of Muſcovitiſh Tartary, bounded on the north by the Tartars of Tumen, on the eaſt by Barabinſkoi, on the ſouth by the mountain Sortora, and on the weſt by the dutchy of Bulgaria.

BASON, in anatomy. See Pelvis.

Bason, in hydraulics, a reſervoir of water, uſed for various purpoſes: Thus we ſay, *The baſon of a jet d'eau, the baſon of a fountain*, and likewiſe *the baſon of a port* or *harbour*.

Bason, in Jewiſh antiquities, the laver of the tabernacle, made of the braſs looking-glaſſes belonging to thoſe devout women that watched and ſtood centinels at the door of the tabernacle.

Bason, in mechanics, a term uſed by glaſs-grinders for a diſh of copper, iron, &c. in which they grind convex glaſſes, as concave ones are formed on ſpheres: And by hatters for a round iron mould, in which they form the matter of their hats; and alſo for a leaden one for the brims of hats, having an aperture in the middle, of a diameter ſufficient for the largeſt block to go through.

Basons *of a balance*, the two ſcales or diſhes faſtened to the extremities of the ſtrings, the one to hold the weight, and the other the thing to be weighed.

Sale by the Bason, at Amſterdam, is a public ſale made by authority, over which preſides an officer, appointed by the magiſtrates. It is ſo called, becauſe, before the lots are delivered to the higheſt bidder, they commonly ſtrike on a copper baſon, to give notice that the lot is going to be adjudged.

BASQUE, or Labour, the ſouth-weſt diviſion of the province of Gaſcony, in France.

BASS, in muſic, that part of a concert which is moſt heard, which conſiſts of the graveſt and deepeſt ſounds, and which is played on the largeſt pipes or ſtrings of a common inſtrument, as of an organ, lute, &c. or on inſtruments larger than ordinary, for that purpoſe, as baſs-viols, baſſoons, baſs-hautboys, &c. The baſs is the principal part of a muſical compoſition, and the foundation of harmony; for which reaſon it is a maxim among muſicians, That when the baſs is good, the harmony is ſeldom bad.

Thorough-Bass is the harmony made by the baſs-viols, or theorbos, continuing to play both while the voices ſing, and the other inſtruments perform their parts, and alſo filling up the intervals when any of the other parts ſtop. It is played by cyphers marked over the notes, on the organ, ſpinet, harpſicord, &c. and frequently ſimply and without cyphers on the baſs-viol and baſſoon.

Counter-Bass is a ſecond or double baſs, where there are ſeveral in the ſame concert.

Bass, in geography, a ſteep rock, with an old fort, acceſſible only at one place, lying on the coaſt of E. Lothain in Scotland, at the mouth of the frith of Forth.

BASSAIM, or BACCEIM, a port-town of the Hither India, ſubject to the Portugueſe, ſituated in 71° 5′ E. long. and 19° 30′ N. lat.

BASSANUS, in ornithology. See Pelicanus.

BASSEE, a town of French Flanders, upon the confines of Artois, ſituated in 3° 30′ E. lon. and 50° 53′ N. lat.

BASSEMPOIN, a town of Gaſcony, in France.

BASSET, a game at cards, ſaid to have been invented by a noble Venetian, for which he was baniſhed.

The perſons concerned in it are a dealer, or banker; his aſſiſtant, who ſuperviſes the loſing cards; and the punter, or any one who plays againſt the banker.

BASSIGNY, the ſouth eaſt diviſion of the province of Champaign, in France. See Campaign.

BASSOON, a muſical inſtrument of the wind-ſort, blown with a reed, furniſhed with eleven holes, and uſed as a baſs in a concert of hautboys, flutes, &c.

To render this inſtrument more portable, it is divided into two parts, whence it is alſo called a fagot. Its diameter at bottom is nine inches, and its holes are ſtopped like thoſe of a large flute.

BASSORA, a large city of Aſia, ſituated below the conflux of the Tigris and Euphrates, in 53° E. long. and 30° 20′ N. lat.

BASSO-RELIEVO, or Bass-relief, a piece of ſculpture, where the figures or images do not protuberate, jet, or ſtand out far above the plane on which they are formed.

Whatever figures or repreſentations are thus cut, ſtamped, or otherwiſe wrought, ſo that not the entire body, but only part of it is raiſed above the plane, are ſaid to be done in relief, or relievo; and when that work is low, flat, and but a little raiſed, it is called low relief: When a piece of ſculpture, a coin, or a medal, has its figure raiſed ſo as to be well diſtinguiſhed, it is called bold, and we ſay its relief is ſtrong.

BASS-VIOL, a muſical inſtrument of the like form with that of a violin, but much larger. It is ſtruck with a bow as that is, has the ſame number of ſtrings, and has eight ſtops, which are ſubdivided into ſemi-ſtops. Its ſound is grave, and has a much nobler effect in a concert than that of the violin.

BASTERNA, a ſort of vehicle, much the ſame with our chariot, uſed by the ancient Roman ladies. This was a different carriage from the lectica, which it ſucceeded,

ceded, inasmuch as the lectica was borne on mens shoulders, whereas this was drawn by beasts.

BASTIA, the chief city of the island of Corsica. It is a good port, situated on the north-east part of the island, in 9° 40′ E long. and 42° 20′ N. lat.

BASTILE, a castle for state prisoners in Paris, answering to the Tower of London.

BASTIMENTOS, small islands on the coast of Darien, in South America, lying a little to the eastward of Porto Bello.

BASTION, in the modern fortification, a huge mass of earth, faced usually with sods, sometimes with brick, and rarely with stone, standing out from a rampart, whereof it is a principal part, and is what, in the ancient fortification, was called a bulwark. See FORTIFICATION.

Solid BASTIONS are those that have the void space within them filled up entirely, and raised of an equal height with the rampart.

Void and hollow BASTIONS are those that are only surrounded with a rampart and parapet, having the space within void and empty, where the ground is so low, that if the rampart be taken, no retrenchment can be made in the centre, but what will lie under the fire of the besieged.

Flat BASTION, is a bastion built in the middle of the curtain, when it is too long to be defended by the bastion at its extremes.

Cut BASTION is that whose point is cut off, and instead thereof has a re-entering angle, or an angle inwards with two points outwards, and is used either when without such a contrivance the angle would be too acute, or when water or some other impediment hinders the carrying on the bastion to its full extent.

Composed BASTION is when two sides of the interior polygon are very unequal, which makes the gorges also unequal.

Deformed BASTION is when the irregularity of the lines and angles makes the bastion out of shape, as when it wants one of its demigorges, one side of the interior polygon being too short.

Demi BASTION is composed of one face only, and but one flank, and a demigorge.

Double BASTION is that which is raised on the plane of another bastion.

Regular BASTION is that which has its true proportion of faces, flanks, and gorges.

BASTION DE FRANCE, a fortress in the kingdom of Tunis, subject to France. It is situated about 80 miles west of the city of Tunis, in 8° E. long. and 36° 30′ N. lat.

BASSTOIGNE, a town of the Netherlands, in the province of Luxemburg, situated in 5° 26′ E. long. and 50° N. lat.

BASTON, in law, one of the servants to the warden of the Fleet prison, who attends the king's courts with a red staff, for taking into custody such as are committed by the court. He also attends on such prisoners as are permitted to go at large by licence.

BASTON, or BATOON, in architecture, a moulding in the base of a column, called also a tore.

BASTON, or BATOON, in heraldry, a kind of bend, having only one third of the usual breadth.

The baston does not go from side to side, as the bend or scarf does, being in the form of a truncheon. Its use is a note or mark of bastardy. See Plate LI. fig. 9.

BASTONADE, or BASTINADO, a kind of punishment inflicted by beating the offender with a stick. This sort of beating, among the ancient Greeks and Romans, was the punishment commonly inflicted on criminals that were freemen, as that of whipping was on the slaves. We find some instances of this sort of discipline among the Hebrews; and it is a penalty used in the east even at this day.

BAT, in zoology. See VESPERTILIO.

BAT, BATE, or BATZ, a small copper coin, mixed with a little silver, current in several cities of Germany: it is worth four crutzers. It is also a coin in Switzerland, current at five livres, or one hundred sols, French money.

BATABLE *ground*, that land which lay between Scotland and England, when the kingdoms were distinct, to which both nations pretended a right.

BATACALO, a fort and town on the eastern coast of the island of Ceylon, in 81° E. long. and 8° N. lat.

BATAVIA, the capital of all the Dutch colonies and settlements in the East Indies. It is situated on the east part of the island of Java, and has an excellent harbour, in 106° E. long. and 6° S. lat.

BATCHELOR, or BACHELOR, a man who still continues in the state of celibacy, or who was never married.

BATCHELOR was anciently a denomination given to those who had attained to knighthood, but had not a number of vassals sufficient to have their banner carried before them in the field of battle; or, if they were not of the order of bannerets, were not of age to display their own banner, but obliged to march to battle under another's banner. It was also a title given to young cavaliers, who having made their first campaign, received the military girdle accordingly. And it served to denominate him who had overcome another in a tournament, the first time he ever engaged.

Knights BATCHELORS were so called, as being the lowest order of knights, or inferior to bannerets.

BATCHELORS, in an university-sense, are persons that have attained to the baccalaureate, or who have taken the first degree in the liberal arts and sciences. Before a person can be admitted to this degree at Oxford, it is necessary that he study there four years; three years more may intitle him to the degree of master of arts; and in seven years more he may commence batchelor of divinity. At Cambridge the degrees are usually taken much the same as at Oxford, excepting in law and physic, in either of which the batchelor's degree may be taken in six years. In France, the degree of batchelor of divinity is attained in five year's study; that is, in two years of philosophy, and three of divinity.

BAT-FOWLING, a method of catching birds in the night, by lighting some straw, or torches, near the place

place where they are at rooſt; for upon beating them up, they fly to the flame, where being amazed, they are eaſily caught in nets, or beat down with buſhes fixed to the end of poles, *&c.*

BATENBOURG, a town of the United Provinces, ſituated upon the Maeſe, between Ravenſtein and Megen.

BATH, a ſufficient quantity of water collected in ſome convenient receptacle, for people to waſh in, either for health or pleaſure.

Baths are diſtinguiſhed into natural and artificial, and natural again into hot and cold. The chief hot baths in our country are thoſe at Bath, near Wells, in Somerſetſhire; and thoſe at Buxton and Matlock in Derbyſhire.

In the city of Bath are four hot baths: one triangular, called the croſs bath, the heat of which is more gentle than that of the reſt, becauſe it has fewer ſprings in it; the ſecond is the hot bath, which was formerly much hotter than the reſt, but it was then not ſo large as at preſent: the other two are the King's and Queen's Bath, divided only by a wall; the laſt having no ſpring, but receives its water from the King's Bath: each of theſe is furniſhed with a pump, to throw out the water upon the diſeaſed, where that is required.

Theſe waters abound with a mineral ſulphur; they are hot, of a bluiſh colour, and ſtrong ſcent; they do not paſs through the body like moſt other mineral waters; though if ſalt be added, they purge preſently. On ſettlements, they afford a black mud, which is uſed by way of cataplaſm in aches, and proves of more ſervice to ſome than the waters themſelves: The like they depoſite on diſtillation, and no other: The croſs-bath preys on ſilver, all of them on iron, but none on braſs.

The uſe of theſe baths is found beneficial in diſorders of the head, as palſies, *&c.* in cuticular diſeaſes, as leproſies, *&c.* obſtructions, and conſtipations of the bowels, the ſcurvy and ſtone, and in moſt diſeaſes of women and children; they are uſed as a laſt remedy in obſtinate chronic diſeaſes, where they ſucceed well, if they agree with the conſtitution of the patient.

Of the three hot European waters of note, *viz.* Aix-la-Chapelle, Bourbon, and Bath, the firſt abounds more eminently in ſulphur, which makes its heat, nauſeouſneſs, and purgative faculty ſo great, that few ſtomachs can bear it.

The Bourbon are of a middle nature, between the Aix-la-Chapelle and the Bath waters; being leſs hot, nauſeous, and purgative than thoſe of Aix-la-Chapelle; but more ſo than the Bath waters.

Cold baths were by the ancients held in the greateſt eſteem; and though they were long baniſhed out of medicine, the preſent age can boaſt of abundance of noble cures performed by them, and ſuch as were long attempted in vain by the moſt powerful medicines.

The cold bath is ſerviceable in moſt chronic diſorders; it always acts the part of a diuretic; and will do more, eſpecially plunging over head in ſea-water, in the cure of melancholy, madneſs, and particularly that occaſined by the bite of a mad dog, than any other medicine.

Artificial baths are various, according to the various occaſions; as aqueous baths, vaporous baths, dry baths, *&c.* Aqueous baths are made from common plants, and other emollient, reſolvent, and nervine ſubſtances; conſiſting ſometimes of milk and emollient herbs, with roſe-water, *&c.* when the deſign is to humectate, or when it is only to cleanſe, it conſiſts of bran and water alone; and when it is for an exceſſive pain or tumour, *&c.* in theſe caſes it conſiſts of a decoction of roots, plants, and ſome ſpirit of wine.

In vapour-baths, the deſign of which is to promote a perſpiration, the ſteam or fume of ſome decoction is received upon ſome part of the body for that purpoſe. In theſe baths there is no part of the patient's body plunged into the decoction, only thoſe parts which require it are properly diſpoſed to receive the ſteams of ſome proper fomentation. Of this kind are the bagnios, where perſons are made to ſweat by the heat of a room, and pouring on of hot water.

Vapour-baths are of ſingular ſervice in cold diſtempers, anaſarca's, œdematous tumours, paralytic caſes, ſwellings of the teſticles, *&c.*

Dry baths are made of aſhes, ſalt, ſand, ſhreds of leather, *&c.* This bath is ſucceſsful in provoking ſweat in a plentiful manner, the patient being placed conveniently for the reception of the fumes: They are found uſeful in removing old obſtinate pains, and are very effectual in venereal complaints.

Bath, in Hebrew antiquity, a meaſure of capacity, containing the tenth part of an omer, or ſeven gallons and four pints, as a meaſure for things liquid; or three pecks and three pints, as a meaſure for things dry.

Baths, in architecture, ſuperb buildings, erected for the ſake of bathing.

Thoſe buildings, among the ancients, were moſt pompous and magnificent; ſuch were thoſe of Titus, Paulus Æmilius, and Diocleſian, whoſe ruins are ſtill remaining.

Bath, in geography, a city of Somerſetſhire, ſituated on the river Avon, ten miles eaſt of Briſtol, in 2° 30′ W. long. and 51° 30′ N. lat.

Bath is alſo the name of a town in Hungary, in 20° 40′ E. long. and 46° N. lat.

Knights of the Bath, a military order in England, ſuppoſed to have been inſtituted by Richard II. who limited their number to four: However, his ſucceſſor, Henry IV. increaſed them to forty-ſix. Their motto was *tres in uno*, ſignifying the three theological virtues.

This order received this denomination from a cuſtom of bathing, before they received the golden ſpur. It is ſeldom ever conferred but at the coronation of kings, or the inauguration of a prince of Wales or Duke of York. They wear a red ribbon beltwiſe.

The order of the bath, after remaining many years extinct, was revived under George I. by a ſolemn creation of a great number of knights.

Bath-*kol*, the daughter of a voice. So the Jews call one of their oracles, which is frequently mentioned in their books, eſpecially the Talmud, being a fantaſtical way of divination invented by the Jews themſelves, not unlike the *ſortes virgilianæ* of the heathens. However,

ever, the Jewiſh writers call this a revelation from God's will, which he made to his choſen people, after all verbal prophecies had ceaſed in Iſrael.

BATH-*metal*, a mixed metal, otherwiſe called *prince's metal*. See PRINCE's METAL.

BATH-*water*. See the article BATH.

BATHA, the name of two towns, the one in Barbary, in the kingdom of Algiers, and the other in Hungary, upon the banks of the Danube.

BATHING, the waſhing, ſoaking, ſuppling, refreſhing, moiſtening, *&c.* the body, or any part thereof, in water, liquor, *&c.* for pleaſure or health. See BATH.

BATHING *a falcon*, is when, weaned from her ramage fooleries, ſhe is offered ſome water to bathe herſelf in a baſon, where ſhe may ſtand up to her thighs. By this means ſhe gathers ſtrength and boldneſs.

BATHMUS, in anatomy, denotes the cavity of a bone, fitted to receive the prominence of another bone.

BATICALA, in geography, a kingdom of India, upon the coaſt of Malabar, to the north of the kingdom of Canara.

BATIS, in zoology, the trivial name of a ſpecies of raja. See RAJA.

BATMAN, in commerce, a kind of weight uſe at Smyrna, containing ſix okes of four hundred drams each, which amount to ſixteen pounds, ſix ounces, and fifteen drams of Engliſh weight.

BATON, or BASTON. See BASTON.

BATRACHITES, or FROG-STONE, a kind of gem mentioned by the ancients, and ſo called from its reſembling the colour of a frog.

BATRACHOMYOMACHIA, the battle of the frogs and the mice, the title of a fine burleſque poem, uſually aſcribed to Homer.

The ſubject of the work is the death of Pſycharpax, a mouſe, ſon to Toxartes, who, being mounted on the on the back of Phyſignathus, a frog, on a voyage to her palace, to which ſhe had invited him, was ſeized with fear, when he ſaw himſelf in the middle of the pond, ſo that he tumbled off and was drowned. Phyſignathus being ſuſpected to have ſhaken him off with deſign, the mice demanded ſatisfaction, and unanimouſly declared war againſt the frogs.

BATTA, a province of the kingdom of Congo in Africa, which is watered by the river Barbela.

BATTALIA, denotes an army drawn up in order of battle.

BATTALION, a ſmall body of infantry, ranged in form of battle, and ready to engage.

A battalion uſually contains from 5 to 800 men; but the number it conſiſts of is not determined. They are armed with firelocks, ſwords, and bayonets; and divided into thirteen companies, one of which is grenadiers. They are uſually drawn up with ſix men in file, or one before another. Some regiments conſiſt but of one battalion, others are divided into four or five.

BATTEL, a town of Suſſex, ſix miles north of Haſtings, in 35′ E. long. and 50° 55′ N. lat.

BATTEN, a name that workmen give to a ſcantling of wooden ſtuff, from two to four inches broad, and about one inch thick; the length is pretty conſiderable, but undetermined.

This term is chiefly uſed in ſpeaking of doors and windows of ſhops, *&c.* which are not framed of whole deal, *&c.* with ſtyles, rails, and pannels like wainſcot, but are made to appear as if they were, by means of theſe battens, bradded on the plain board round the edges, and ſometimes croſs them, and up and down.

BATTENBURY, a town of Dutch Guelderland, ſituated on the north ſhore of the river Maeſe, almoſt oppoſite to Ravenſtein, in 5° 30′ E. long. and 51° 45′ N. lat.

BATTERING, the attacking a place, work, or the like, with heavy artillery.

To batter in breach, is to play furiouſly on a work, as the angle of a half-moon, in order to demoliſh and make a gape therein. In this they obſerve never to fire a piece at the top, but all at the bottom, from three to ſix feet from the ground.

The battery of a camp is uſually ſurrounded with a trench, and palliſadoes at the bottom, with two redoubts on the wings, or certain places of arms, capable of covering the troops which are appointed for their defence. See BATTERY.

BATTERING-*pieces*, or pieces of battery. See CANNON and GUNNERY.

BATTERING-*ram*, in antiquity. See RAM.

BATTERING-*rams*, in heraldry, a bearing, or coat of arms, reſembling the military enſign of the ſame name. See Plate LI. fig. 10.

BATTERY, in the military art, a parapet thrown up to cover the gunners, and men employed about the guns, from the enemy's ſhot. This parapet is cut into embraſſures, for the cannon to fire through. The height of the embraſſures, on the inſide, is about three feet; but they go ſloping lower to the outſide. Their wideneſs is two or three feet, but open to ſix or ſeven on the outſide. The maſs of earth that is betwixt two embraſſures, is called the *merlon*. The platform of a battery is a floor of planks and ſleepers, to keep the wheels of the guns from ſinking into the earth; and is always made ſloping towards the embraſſures, both to hinder the reverſe, and to facilitate the bringing back of the gun.

BATTERY *of mortars* differs from a battery of guns, for it is ſunk into the ground, and has no embraſſures.

Croſs-BATTERIES are two batteries, which play athwart one another, upon the ſame thing, forming there an angle, and beating with more violence and deſtruction; becauſe what one bullet ſhakes, the other beats down.

BATTERY *ſunk* or *buried*, is when its platform is ſunk, or let down into the ground, ſo that there muſt be trenches cut in the earth, againſt the muzzles of the guns, for them to fire out at, and to ſerve for embraſſures.

BATTERY *d'enfilade*, is one that ſcours, or ſweeps the whole length of a ſtraight line.

BATTERY *en echarpe* is that which plays obqliuely.

BAT-

BATTERY *de reverſe*, that which plays upon the enemy's back.

Camerade BATTERY is when ſeveral guns play at the ſame time upon one place.

BATTERY, in law, the ſtriking, beating, or offering any violence to another perſon, for which damages may be recovered.

BATTEURS *d'eſtrade*, or SCOUTS, are horſemen ſent out before, and on the wings of an army, one, two, or three miles, to make diſcoveries.

BATTLE, a general engagement between two armies, in a country ſufficiently open for them to encounter in front, and at the ſame time.

Other great actions, though of a longer duration, and even attended with a greater ſlaughter, are only called fights.

Naval BATTLE, the ſame with a ſea-fight, or engagement between two fleets of men of war.

Before a naval battle, every ſquadron uſually ſubdivides itſelf into three equal diviſions, with a reſerve of certain ſhips out of every ſquadron to bring up their rear. Every one of theſe, obſerving a due birth and diſtance, are in the battle to ſecond one another; and the better to avoid confuſion and falling foul of each other, to charge, diſcharge, and fall off, by threes or fives, more or leſs, as the fleet is greater or ſmaller. The ſhips of reſerve are inſtructed either to ſuccour and relieve thoſe that are any way in danger; or to ſupply, and put themſelves in the place of thoſe that ſhall be made unſerviceable.

As for a fleet conſiſting but of few ſhips, when obliged to fight in an open ſea, it ſhould be brought up to battle in only one front, with the chief admiral in the middle of them, and on each ſide of him the ſtrongeſt and beſt provided ſhips of the fleet.

BATTLE is alſo uſed figuratively, for a repreſentation of a battle in ſculpture, painting, and the like.

BATTLE-*royal*, in cock-fighting, a fight between three, five, or ſeven cocks all engaged together, ſo that the cock which ſtands longeſt gets the day.

BATTLE-*ax*, a kind of halbard, firſt introduced into England by the Danes.

BATTLEMENTS, in architecture, are indentures or notches in the top of a wall or other building, in the form of embraſſures, for the ſake of looking though them.

BATTOLOGY, in grammar, a ſuperfluous repetition of ſome words or things.

BATTON, BATOON, or BASTON. See BASTON.

BATTORY, in commerce, a name given by the Hanſe towns to their country-houſes and warehouſes in foreign countries. The principal battories were at London, Archangel, Novogorod, Liſbon, Venice, and Antwerp.

BATTUS, an order of penitents at Avignon, and in Provence, whoſe piety carries them to exerciſe very ſevere diſcipline upon themſelves, both in public and private.

BATUECOS, or LOS BATUECOS, a people of Spain in the kingdom of Leon, that inhabit the mountains between Salamanca and Corica, and are thought to be deſcended from the Goths

BATZ, a copper coin mixed with ſome ſilver, and current at different rates, according to the alloy, in Nuremberg, Baſil, Fribourg, Lucerne, and other cities of Germany and Switzerland.

BAVARIA, one of the circles of the German empire, lying between Auſtria on the eaſt, and Swabia on the weſt.

The duke of Bavaria is one of the nine electors. See ELECTOR.

BAVAY; a ſmall town in the province of Hainalt in French Flanders, about twelve miles ſouth-weſt of Mons, in 3° 40′ E. long, and 50° 25′ N. lat.

BAUHINIA, in botany, a genus of the decandria monogynia claſs. The calix has five diviſions, and is deciduous; the petals are open, oblong, and inſerted by claws into the calix. The ſpecies are eight, all natives of the Indies.

BAVINS, in the military art, denote bruſh-faggots, with the bruſh at length.

BAUM, in botany. See MELISSA.

BAURAC, a name anciently uſed for nitre.

BAUTZEN, the chief town of Luſatia in Germany, about thirty-five miles north-eaſt of Dreſden, in 14° 30′ E. long. and 51° 15′ N. lat.

BAWLING, among ſportſmen, the ſame with babbling. See BABBLING.

BAY, in geography, an arm of the ſea ſhooting up into the land, and terminating in a nook. It is a kind of leſſer gulf, bigger than a creek, and is larger in its middle within than at its entrance. The largeſt and moſt noted bays in the world are thoſe of Biſcay, Bengal, Hudſon's, Panama, *&c.*

BAY, among farmers, a term uſed to ſignify the magnitude of a barn; as, if a barn conſiſts of a floor and two heads, where they lay corn, they call it a *barn of two bays*. The bays are from fourteen to twenty feet long.

BAY denotes likewiſe a pound head, made to keep in ſtore of water for driving the wheels of the furnace or hammer belonging to an iron-mill, by the ſtream that comes thence through a flood-gate, called the *pen-ſtock*.

BAY is alſo one of the colours of the hair of horſes, inclining to red, and coming pretty near the colour of a cheſnut. There are five different gradations of the bay-colour, *viz.* cheſnut-bay, light-bay, yellow-bay or dun-day, bloody-bay, which is alſo called ſcarlet-bay, and the brown-bay.

BAY, among huntſmen. Deer are ſaid to ſtand at bay, when, after being hard run, they turn head againſt the hounds.

BAY-*tree*, See LAURUS.

BAY-*ſalt*. See SALT.

BAYEUX, a city of Normandy in France, about fifteen miles north-weſt of Caen, in 50′ W. long. and 49° 20′ N. lat.

BAYONET, in the military art, a ſhort broad dagger, formerly with a round handle fitted for the bore of a firelock, to be fixed there after the ſoldier had fired; but they are now made with iron handles and rings, that

that go over the muzzle of the firelock, and are ſcrewed faſt, ſo that the ſoldier fires with his bayonet on the muzzle of his piece, and is ready to act againſt the horſe.

BAYONNE, a large city of Gaſcony in France, ſituated on the river Adour, near the bay of Biſcay, in 1° 20′ W. long. and 43° 30′ N. lat.

BAYS, in commerce, a ſort of open woollen ſtuff, having a long nap, ſometimes frized, and ſometimes not. This ſtuff is without wale, and is wrought in a loom with two treddles, like flannel. It is chiefly manufactured at Colcheſter and Bockin in Eſſex, where there is a hall called the *Dutch bay-hall* or *raw-hall*. The exportation of bays was formerly much more conſiderable than at preſent that the French have learned to imitate them. However, the Engliſh bays are ſtill ſent in great quantities to Spain and Portugal, and even to Italy. Their chief uſe is for dreſſing the monks and nuns, and for linings, eſpecially in the army. The looking-glaſs makers alſo uſe them behind their glaſſes, to preſerve the tin or quickſilver; and the caſe-makers, to line their caſes. The breadth of bays is commonly a yard and a half, a yard and three quarters, or two yards, by 42 to 48 in length. Thoſe of a yard and three quarters are moſt proper for the Spaniſh trade.

BAZAR, Bazari, or Bazaard, a place deſigned for trade among the eaſtern nations, particularly the Perſians, ſome of which are open at top, like the market-places of Europe; others are covered with high-vaulted ceilings, and adorned with domes to give light. In the firſt, they ſell ony the leſs precious and moſt bulky commodities; whereas, in the latter, are the ſhops of thoſe merchants who ſell jewels, rich ſtuffs, wrought plate, *&c.*

BAZAS, a town of Guienne in France, about thirty miles ſouth of Bourdeaux, in 25′ W. long. and 44° 20′ N. lat.

BAZAT, or Baza, in commerce, a long, fine, ſpun cotton, which comes from Jeruſalem, whence it is alſo called *Jeruſalem-cotton*.

BDELLIUM, is a gummy reſinous concreted juice, brought from Arabia and the E. Indies, in globes of different figures and magnitudes. It is of a dark reddiſh brown colour, and, in appearance, ſomewhat reſembles myrrh; and is recommended as a ſudorific, diuretic, and uterine; and in external applications, for maturating tumours, *&c.* In the preſent practice, it is ſcarce otherwiſe made uſe of, than as an ingredient in theriaca.

BEACHY-HEAD, a cape or promontory on the coaſt of Suſſex, between Haſtings and Shoreham.

BEACON, any public ſignal, to give warning againſt rocks, ſhelves, invaſions, *&c.*

BEACONAGE, a tax or farm paid for the uſe and maintenance of a beacon. Trinity-houſe is empowered to levy this tax by act of parliament.

BEACONFIELD, a market-town of Buckinghamſhire, twenty-two miles weſt of London, in 30′ W. long. and 51° 30′ N. lat.

BEAD, a ſmall glaſs ball, made in imitation of pearl, and uſed in necklaces, *&c.*

Bead, in architecture, a round moulding, commonly made upon the edge of a piece of ſtuff, in the Corinthian and Roman orders, cut or carved in ſhort emboſſments, like beads in necklaces.

Bead-*proof*, among diſtillers, a fallacious way of determining the ſtrength of ſpirits, from the continuance of the bubbles, or beads, raiſed by ſhaking a ſmall quantity of them in a phial.

Bead-*roll*, among papiſts, a liſt of ſuch perſons, for the reſt of whoſe ſouls they are obliged to repeat a certain number of prayers, which they count by means of their beads.

BEADLE, a meſſenger or apparitor of a court, who cites perſons to appear and anſwer in the court to what is alledged againſt them.

Beadle is alſo an officer at an univerſity, whoſe chief buſineſs it is to walk before the maſters with a mace, at all public proceſſions.

BEAGLE, the name of a particular kind of hunting-dogs, of which there are ſeveral ſorts, *viz.* the ſouthern beagle, which is ſomething leſs than the deep-mouthed hound, and ſomething thicker and ſhorter; the fleet-nothern, or cat-beagle, which is ſmaller and of a finer ſhape than the ſouthern beagle, and is a hard runner: There is alſo a very ſmall beagle, not bigger than a lady's lap-dog.

BEAK, the bill or nib of a bird.

Beak, in architecture, the ſmall fillet left on the head of a larmier, which forms a canal, and makes a kind of pendant.

Chin Beak, a moulding the ſame as the quarter-round, except that its ſituation is inverted: This is very frequent in modern buildings, though few examples of it are found in the ancient.

Beak, or Beak-*head*, of a ſhip, that part without the ſhip, before the fore-caſtle, which is faſtened to the ſtem, and is ſupported by the main knee.

BEAKED, in heraldry, a term uſed to expreſs the beak or bill of a bird. When the beak and legs of a fowl are of a different tincture from the body, we ſay beaked and membered of ſuch a tincture.

BEAKING, among cock-fighters, is when one cock holds another by his bill, and ſtrikes him with his ſpurs or gafflers at the ſame time.

BEAM, in architecture, the largeſt piece of wood in a building, which lies croſs the walls, and ſerves to ſupport the principal rafters of the roof, and into which the feet of theſe rafters are framed.

Beams *of a ſhip* are the great main croſs-timbers which hold the ſides of the ſhip from falling together, and which alſo ſupport the decks and orlops: The main beam is next the main-maſt, and from it they are reckoned by firſt, ſecond, third beam, *&c.* the greateſt beam of all is called the *mid-ſhip beam*. See Ship.

Beam-*compaſs*, an inſtrument conſiſting of a ſquare wooden or braſs beam, having ſliding ſockets, that carry ſteel or pencil points; they are uſed for deſcribing large circles, where the common compaſſes are uſeleſs.

Beam, in heraldry, the term ufed to exprefs the main horn of a hart or buck.

Beam, among hunters, the main ftem of a deer's head, or that part which bears the antlers, royals, and tops.

Chamber-Beam. See Chamber-*beam*.

Beam is alfo the name of a fort of fiery meteor in the fhape of a pillar; alfo a ray of the fun.

Beam-*filling*, in building, the filling up of the vacant fpace between the raifon and roof, with ftones or bricks laid between the rafters on the raifon, and plaftered on with loam, where the garrets are not pargeted, or plaftered, as in country places, where they do not parget or plafter their garrets.

Beam *of an anchor*, the longeft part of it, called alfo the *fhank*.

Beam-*feathers*, in falconry, the longeft feathers of a hawk's wing.

Beam alfo denotes the lath, or iron, of a pair of fcales; fometimes the whole apparatus for weighing of goods is fo called: Thus we fay, it weighs fo much at the king's beam.

Beam *of a plough*, that in which all the parts of the plough-tail are fixed. See Agriculture.

Beam, or Roller, among weavers, a long and thick wooden cylinder, placed length-ways on the back-part of the loom of thofe who work with a fhuttle.

That cylinder, on which the ftuff is rolled as it is weaved, is alfo called the beam or roller, and is placed on the fore-part of the loom.

BEAN, in botany. See Vicia.

BEAR, in zoology. See Ursus.

Bear, in aftronomy. See Ursa.

Bear, in heraldry. He that has a coat of arms is faid to bear in it the feveral charges or ordinaries that are in his efcutcheon.

Bear, in gunnery. A piece of ordnance is faid to come to bear, when it lies right with, or directly againft the mark.

BEARALSTON, a borough of Devonfhire, fituated on the river Tamar, about ten miles north of Plymouth, in 4° 30' W. long. and 50° 35' N. lat. It fends two members to parliament.

Bear's-*breech*. See Acanthus.

BEARD, the hair growing on the chin, and adjacent parts of the face, chiefly of adults and males. See Anatomy. p. 256.

Various have been the ceremonies and cuftoms of moft nations in regard of the beard. The Tartars, out of a religious principle, waged a long and bloody war with the Perfians, declaring them infidels merely becaufe they would not cut their whifkers after the rite of Tartary: And we find, that a confiderable branch of the religion of the ancients confifted in the management of their beard. Ecclefiaftics have fometimes been enjoined to wear, and at other times have been forbid the wearing, the beard; and the Greek and Romifh churches have been a long time by the ears, about their beards. To let the beard grow, in fome countries, is a token of mourning, as to fhave it is the like in others.

The Greeks wore their beards till the time of Alexander the Great, that prince having ordered the Macedonians to be fhaved, for fear it fhould give a handle to their enemies. The Romans did not begin to fhave till the year of Rome 454. Nor did the Ruffians cut their beards till within thefe few years, that Peter the Great, notwithftanding his injunction upon them to fhave, was obliged to keep on foot a number of officers to cut off, by violence, the beards of fuch as would not otherwife part with them.

Beard *of a comet*, the rays which the comet emits towards that part of the heaven to which its proper motion feems to direct it, in which the beard of a comet is diftinguifhed from the tail, which is underftood of the rays emitted towards that part from whence its motion feems to carry it.

Beard *of a horfe*, that part underneath the lower mandible on the outfide and above the chin, which bears the curb. It is alfo called the chuck.

It fhould have but little flefh upon it, without any chops, hardnefs, or fwelling, and neither too high raifed nor too flat, but fuch as the curb may reft in its right place.

BEARDED *hufk*, among florifts, is a hufk, hairy on the edges.

BEARDING *of wool*. See Wool.

BEARER, in architecture, a poft, or brick-wall, trimmed up between the two ends of a piece of timber, to fhorten its bearing, or to prevent its bearing with the whole weight at the ends only.

Bearer *of a bill of exchange*, the perfon in whofe hands the bill is, and in favour of whom the laft order was made.

When a bill is made payable to the bearer, it is underftood to be payable to him in whofe hands it is, after it becomes due. See Bill.

BEARERS, in heraldry. See Supporters.

Crofs-Bearers. See Cross.

BEARING, in navigation and geography, the fituation of one place from another, with regard to the points of the compafs; or the angle which a line drawn through the two places, makes with the meridians of each.

Bearing, in the fea language. When a fhip fails towards the fhore, before the wind, fhe is faid bear in with the land or harbour. To let the fhip fail more before the wind, is to bear up. To put her right before the wind, is to bear round. A fhip that keeps off from the land, is faid to bear off. When a fhip that was to windward comes under another fhip's ftern, and fo gives her the wind, fhe is faid to bear under her lee, *&c*. There is another fenfe of this word, in reference to the burden of a fhip; for they fay a fhip bears, when having too flender or lean a quarter, fhe will fink too deep into the water with an over light freight, and thereby can carry but a fmall quantity of goods. See Navigation.

Bearing *of a piece of timber*, among carpenters, the fpace either between the two fixed extremes thereof, when it has no other fupport, which they call bearing at length, or between one extreme and a poft, brick-wall, *&c*. trimmed up between the ends to fhorten its bearings.

High Bearing *cock*, one larger than the cock he fights with.

Bearing *claws*, among cock-fighters, the foremoſt toes of a cock. If theſe are hurt or gravelled, he cannot fight.

BEARN, a province in the ſouth of France, bounded by Gaſcony on the North, and by the Pyrenean mountains, which ſeparate it from Spain, on the ſouth.

BEAST among gameſters, a game at cards, played in this manner: The beſt cards are the king, queen, *&c.* whereof they make three heaps, the king, the play, and triolet.

Three, four, or five may play; and to every one is dealt five cards. However, before the play begins, every one ſtakes to the three heaps. He that wins moſt tricks, takes up the heap called the play: He that hath the king, takes up the heap ſo called; and he that hath three of any ſort, that is, three fours, three fives, three ſixes *&c.* takes up the triolet heap.

Beast in a general ſenſe, an appellation given to all four-footed animals, fit either for food, labour, or ſport.

Beasts of burden, in a commercial ſenſe, all four-footed animals which ſerve to carry merchandizes on their backs. The beaſts generally uſed for this purpoſe, are elephants, dromedaries, camels, horſes, mules, aſſes, and the ſheep of Mexico and Peru.

Beasts of the chace are five; *viz.* the buck, the doe, the fox, the roe, and the martin.

Beasts and *fowls* of the warren, are the hare, the coney, the pheaſant, and partridge.

Beasts of the foreſt are the hart, hind, hare, boar, and wolf

Rother-Beasts. See Rother.

BEAT, in a general ſignification, ſignifies to chaſtiſe, ſtrike, knock, or vanquiſh

This word has ſeveral other ſignifications in the manufactures, and in the arts and trades. Sometimes it ſignifies to forge and hammer, in which ſenſe ſmiths and farriers ſay, to beat iron; ſometimes it means to pound, to reduce into powder: Thus we ſay, *to beat drugs, to beat pepper, to beat ſpices*; that is to ſay, *to pulveriſe them.*

Beat *of drum*, in the military art, is to give notice by beat of drum of a ſudden danger; or, that ſcattered ſoldiers may repair to their arms and quarters, is to beat an alarm, or to arms; alſo to ſignify, by different manners of ſounding a drum, that the ſoldiers are to fall on the enemy; to retreat before, in, or after an attack; to move, or march, from one place to another; to treat upon terms, or confer with the enemy; to permit the ſoldiers to come out of their quarters at break of day: to order to repair to their colours, *&c.* is to beat a charge, a retreat, a march, *&c.*

BEATIFIC Vision. See Vision.

BEATIFICATION, among papiſts, an act by which the pope declares a perſon beatified, or bleſſed after death.

This is the firſt ſtep towards canonization, and differs from it; becauſe in the former, the pope does not act as a judge, determining the ſtate of the beatified, but only gives a privilege to certain perſons to honour him by a particular religious worſhip, without incurring the penalty of ſuperſtitious worſhip; whereas in canonization, the pope ſpeaks like a judge, and determines upon the ſtate of the canonized.

No perſon can be beatified till fifty years after death. All certificates or atteſtations of virtues and miracles are examined before the congregation of rites: The examination continues for ſeveral years, after which his holineſs decrees the beatification. The corpſe and relics of the future ſaint are thenceforth expoſed to the veneration of every body; his images are crowned with rays, and a particular office is ſet apart for him.

BEATING, or Pulsation, in medicine, the reciprocal agitation or palpitation of the heart or pulſe. See Pulse.

Beating *gold and ſilver*. See Gold-beating, *&c.*

Beating with hunters, a term uſed of a ſtag, which runs firſt one way, and then another. He is then ſaid *to beat up and down.*

The noiſe made by conies in rutting time is alſo called *beating or tapping.*

BEATS, in a watch or clock, are the ſtrokes made by the fangs or pallets of the ſpindle of the ballance, or of the pads in a royal pendulum. See Watch-making.

BEAUCAIRE, a town of Languedoc, ſituated on the weſtern ſhore of the river Rhone, about ſeven miles north of Arles; in 4° 40′ E. long. and 43° 40′ N. lat.

BEAVER, in zoology. See Castor.

BEAUFORT, a town of the duchy of Anjou in France, ſituated 15 miles eaſt of Angers; in 15′ E. long. and 47° 30′ N. lat.

Beaufort is alſo a town of Savoy, about 30 miles eaſt of Chamberry; in 6° 40′ E. long. and 45° 30′ N. lat.

BEAUGENCY, a town of Orleanois, in France; ſituated on the river Loire, about 15 miles ſouth-weſt of Orleans, in 1° 36′ E. long. and 47° 48′ N. lat.

BEAUJEU, a town of the Lyonois in France, about 25 miles north-weſt of Lyons; in 4° 30′ E. long. and 46° 15′ N. lat.

BEAUJOLOIS, the ſouth-eaſt diviſion of the Lyonois, and ſo called from Beaujeu.

BEAUMARIS, a market town of Angleſey in Wales; ſituated about nine miles north of Bangor, in 4° 15′ W. long. and 53° 25′ N. lat.

BEAU-MASS. See Mass.

BEAUMONT, a town of Hainalt, about 17 miles ſouth-eaſt of Mons; in 4° 15′ E. long. and 50° 20′ N lat.

Beaumont is alſo a town of France, about 16 miles ſouth of Alençon; in 5′ E. long. and 48° 20′ N. lat.

BEAUNE, a town of Burgundy in France, ſituated in 5° 20′ E. long. and 47° 2′ N. lat.

BEAUTY, in its native ſignification, is appropriated to objects of ſight. Objects of the other ſenſes may be agreeable, ſuch as the ſounds of muſical inſtruments, the ſmoothneſs and ſoftneſs of ſome ſurfaces; but the agreeableneſs called beauty belongs to objects of ſight.

Objects of ſight are more complex than thoſe of any other ſenſe: In the ſimpleſt, we perceive colour, figure, length, breadth, thickneſs. A tree is compoſed of a trunk, branches, and leaves; it has colour, figure, ſize, and ſometimes motion: By means of each of theſe particulars, ſeparately conſidered, it appears beautiful;

ful; but a complex perception of the whole greatly augments the beauty of the object. The human body is a compofition of numberlefs beauties arifing from the parts and qualities of the object, various colours, various motions, figures, fize, &c. all united in one complex object, and ftriking the eye with combined force. Hence it is, that beauty, a quality fo remarkable in vifible objects, lends its name to every thing that is eminently agreeable. Thus, by a figure of fpeech, we fay, a beautiful found, a beautiful thought, a beautiful difcovery, &c.

Confidering attentively the beauty of vifible objects, two kinds are difcovered. The firft may be termed intrinfic beauty, becaufe it is difcovered in a fingle object, without relation to any other; the other may be termed relative, being founded on the relation of objects. Intrinfic beauty is a perception of fenfe merely; for to perceive the beauty of a fpreading oak, or of a flowing river, no more is required but fingly an act of vifion. Relative beauty is accompanied with an act of underftanding and reflection; for we perceive not the relative beauty of a fine inftrument or engine, until we learn its ufe and deftination. In a word, intrinfic beauty is ultimate; and relative beauty is that of means relating to fome good end or purpofe. Thefe different beauties agree in one capital circumftance, that both are equally perceived as belonging to the object; which will be readily admitted with refpect to intrinfic beauty, but is not fo obvious with refpect to the other. The utility of the plough, for example, may make an object of admiration or of defire; but why fhould utility make it beautiful? A natural propenfity of the human mind will explain this difficulty: By an eafy tranfition of ideas, the beauty of the effect is transferred to the caufe, and is perceived as one of the qualities of the caufe: Thus a fubject void of intrinfic beauty, appears beautiful by its utility; a dwelling-houfe void of all regularity, is however beautiful in the view of convenience; and the want of fymmetry in a tree, will not prevent its appearing beautiful, if it be known to produce good fruit.

When thefe two beauties concur in any object, it appears delightful. Every member of the human body poffeffes both in a high degree.

The beauty of utility, being accurately proportioned to the degree of utility, requires no illuftration: But intrinfic beauty being more complex, cannot be handled diftinctly without being analyfed. If a tree be beautiful by means of its colour, figure, motion, fize, &c. it is in reality poffeffed of fo many different beauties. The beauty of colour is too familiar to need explanation. The beauty of figure is more; for example, viewing any body as a whole, the beauty of its figure arifes from regularity and fimplicity; viewing the parts with relation to each other, uniformity, proportion, and order, contribute to its beauty. The beauties of grandeur and motion muft be confidered feparately. See Grandeur, and Motion.

We fhall here make a few obfervations on fimplicity, which may be of ufe in examining the beauty of fingle objects. A multitude of objects crowding into the mind at once, difturb the attention, and pafs without making any lafting impreffion: In the fame manner, even a fingle object, confifting of a multiplicity of parts, equals not, in ftrength of impreffion, a more fimple object comprehended in one view. This juftifies fimplicity in works of art, as oppofed to complicated circumftances and crowded ornaments.

It would be endlefs to enumerate the effects that are produced by the various combinations of the principles of beauty. A few examples will be fufficient to give the reader fome idea of this fubject. A circle and a fquare are each perfectly regular; a fquare, however, is lefs beautiful than a circle; and the reafon is, that the attention is divided among the fides and angles of a fquare; whereas the circumference of a circle, being a fingle object, makes one entire impreffion: And thus fimplicity contributes to beauty. For the fame reafon, a fquare is more beautiful than a hexagon or octagon. A fquare is likewife more beautiful than a parallelogram, becaufe it is more regular and uniform. But this holds with refpect to intrinfic beauty only; for in many inftances, as in the doors and windows of a dwelling-houfe, utility turns the fcales on the fide of the parallelogram.

Again, a parallelogram depends, for its beauty, on the proportion of its fides: A great inequality of its fides annihilates its beauty: Approximation toward equality hath the fame effect; for proportion there degenerates into imperfect uniformity, and the figure appears an unfuccefsful attempt toward a fquare. And hence proportion contributes to beauty.

An equilateral triangle yields not to a fquare in regularity nor in uniformity of parts, and it is more fimple. But an equilateral triangle is lefs beautiful than a fquare; which muft be owing to inferiority of order in the pofition of its parts; the order arifing from the equal inclination of the fides of fuch an angle, is more obfcure than the parallelifm of the fides of a fquare. And hence order contributes to beauty not lefs than fimplicity, regularity, or proportion.

Uniformity is fingular in one circumftance, that it is apt to difguft by excefs. A number of things deftined for the fame ufe, as windows, chairs, &c. cannot be too uniform. But a fcrupulous uniformity of parts in a large garden or field, is far from being agreeable.

In all the works of nature, fimplicity makes a capital figure. It alfo makes a figure in works of art: Profufe ornament in painting, gardening, or architecture, as well as in drefs or in language, fhows a mean or corrupted tafte. Simplicity in behaviour and manners has an inchanting effect, and never fails to gain our affection. Very different are the artificial manners of modern times. A gradual progrefs from fimplicity to complex forms and profufe ornament, feems to be the fate of all the fine arts; refembling behaviour, which from original candor and fimplicity, has degenerated into duplicity of heart and artificial refinements. At prefent literary productions are crowded with words, epithets, figures: In mufic, fentiment is neglected for the luxury of harmony, and for difficult movement.

With regard to the final caufe of beauty, one thing is evident, that our relifh of regularity, uniformity, proportion,

portion, order, and ſimplicity contributes greatly to enhance the beauty of the objects that ſurround us, and of courſe tends to our happineſs. We may be confirmed in this thought, upon reflecting, that our taſte for theſe particulars is not accidental, but uniform and univerſal, making a branch of our nature. At the ſame time, regularity, uniformity, order, and ſimplicity, contribute, each of them, to readineſs of apprehenſion, and enable us to form more diſtinct ideas of objects than can be done where theſe particulars are wanting. In ſome inſtances, as in animals, proportion is evidently connected with utility, and is the more agreeable on that account.

Beauty, in many inſtances, promotes induſtry, and as it is frequently connected with utility, it proves an additional incitement to enrich our fields and improve our manufactures. Theſe, however, are but ſlight effects, compared with the connections that are formed among individuals in ſociety by means of beauty. The qualifications of the head and heart are undoubtedly the moſt ſolid and moſt permanent foundations of ſuch connections: But, as external beauty lies more in view, and is more obvious to the bulk of mankind than the qualities now mentioned, the ſenſe of beauty has a more extenſive influence in forming theſe connections. At any rate, it concurs in an eminent degree with mental qualifications, in producing ſocial intercourſe, mutual good-will, and conſequently mutual aid and ſupport, which are the life of ſociety. It muſt not however be overlooked, that the ſenſe of beauty does not tend to advance the intereſts of ſociety, but when in a due mean with reſpect to ſtrength. Love, in particular, ariſing from a ſenſe of beauty, loſes, when exceſſive, its ſocial character; the appetite for gratification, prevailing over affection for the beloved object, is ungovernable, and tends violently to its end, regardleſs of the miſery that muſt follow. Love, in this ſtate, is no longer a ſweet agreeable paſſion; it becomes painful, like hunger or thirſt, and produceth no happineſs, but in the inſtant of fruition. This ſuggeſts an important leſſon, that moderation in our deſires and appetites, which fits us for doing our duty, contributes at the ſame time the moſt to happineſs; even ſocial paſſions, when moderate, are more pleaſant than when they ſwell beyond proper bounds.

Beauty, in architecture, painting, and other arts, is the harmony and juſtneſs of the whole compoſition taken together.

BEAUVIN, a city of Burgundy, in France, about 15 miles north of Chalons, in 4° 50′ E. long. and 47° N. lat.

BEAUVOIR, a port-town of France, about 25 miles ſouth-weſt of Nants, in 2° W. long. and 47° N. lat.

BEAUVOIS, a city of the iſle of France, about 43 miles north of Paris, in 2° 20′ E. long. and 4° 30′ N. lat.

BECAH, or Bekah, in Hebrew antiquity, a Jewiſh coin, equal to $13\frac{1}{1}\frac{1}{6}$ *d.* of our money.

BECALM, in a general ſenſe, ſignifies to appeaſe, to allay.

Becalm, in the ſea language. A ſhip is ſaid to be becalmed, when there is not a breath of wind to fill the ſails.

BECANER, the capital of the territory of Becar in India, ſituated on the river Ganges, in 83° E. long. and 28° N. lat.

BECCABUNGA, in botany, the trivial name of a ſpecies of veronica. See Veronica.

BECHICS, medicines deſigned to relieve coughs, being the ſame with what we call *expectorants* and *pectorals*.

BECHIN, a town of Bohemia, in 15° E. long. and 49° 14′ N. lat.

BECKENRIEDT, a town of Switzerland in the canton of Underwaldt.

BECZAU, a town of Bohemia, upon the river Topel.

BED, a machine for ſtretching and compoſing the body on, for eaſe, or ſleep, conſiſting generally of feathers incloſed in a ticken caſe. There are varieties of beds, as a ſtanding-bed, a ſettee-bed, a tent-bed, a truckle-bed, *&c.*

Bed *of juſtice*, in the French cuſtoms, a throne upon which the king is ſeated when he goes to the parliament. The king never holds a bed of juſtice unleſs for affairs that concern the ſtate, and then all the officers of parliament are cloathed in ſcarlet robes.

Bed *of the carriage of a great gun*, a thick plank, that lies under the piece; being, as it were, the body of the carriage.

Bed, in maſonry, a courſe, or range of ſtones; and the joint of the bed is the mortar between two ſtones, placed over each other.

Bed, in gardening, ſquare or oblong pieces of ground, in a garden, raiſed a little above the level of the adjoining ground, and wherein they ſow ſeeds, or plant roots.

Hot-Bed. See Hot-bed.

Lords of the Bed-chamber, in the Britiſh cuſtoms, ten lords who attend in their turns, each a week; during which time they lie in the king's bed-chamber, and wait on him when he dines in private.

BEDAL, a market-town of Yorkſhire, eight miles ſouth of Richmond, in 1° 20′ W. long. and 54° 20′ N. lat.

BEDEL. See Beadle.

BEDEREPE, a cuſtomary ſervice, by which tenants were anciently bound to reap their landlord's corn in harveſt-time.

BEDFORD, the county-town of Bedfordſhire, ſituated on the river Ouſe, about 22 miles ſouth-weſt of Cambridge, in 20′ W. long. and 52° 10′ N. lat.

BED-MOULDING, in architecture, a term uſed for thoſe members of a corniche, which are placed below the coronet; and now uſually conſiſts of an ogee, a liſt, a large boultine, and another liſt under the coronet.

BEDOUINS, in the Arabian cuſtoms, tribes of Arabs, who live in tents, and are diſperſed all over Arabia, Egypt, and the north of Africa.

BEDWIN, a borough-town of Wiltſhire, about 18 miles north-weſt of Saliſbury, in 1° 40′ W. long. and 51° 25′ N. lat.

BEE, in zoology. See APIS.

BEE-EATER, in zoology. See MEROPS.

BEECH, in botany. See FAGUS.

BEECH-GALLS, hard protuberances found on the leaves of the beech, wherein are lodged the maggots of a certain fly.

BEECH-MAST, the fruit of the beech-tree, ſaid to be good for fattening hogs, deer, &c.

BEECH-OIL, an oil drawn by expreſſion from the maſt of the beech-tree, after it has been ſhelled and pounded. This oil is very common in Picardy, and uſed there, and in other parts of France, inſtead of butter; but moſt of thoſe who take a great deal of it, complain of pains and a heavineſs in the ſtomach.

BEELE, a kind of pick-ax, uſed by the miners for ſeparating the ores from the rocks in which they lie: This inſtrument is called a *tubber* by the miners of Cornwall.

BEER, a common and well-known liquor, made with malt and hops. See BREWING, &c.

BEER, among weavers, a term that ſignifies nineteen ends of yarn, running all together the whole length of the cloth.

BEER MEASURE. See MEASURE.

BEESTING, a term uſed by country-people for the firſt milk taken from a cow after calving.

BEET, in botany. See BETA.

BEETLE, in the hiſtory of inſects. See SCARABÆUS.

BEETLE alſo denotes a wooden inſtrument for driving piles, &c. It is likewiſe called a *ſtamper*, and by paviors a *rammer*.

BEFORT, a town of Alſace, ſubject to France, and ſituated about 15 miles north of Baſil, in 7° E. long. and 47° 35′ N. lat.

BEG, or BEY, in the Turkiſh affairs. See BEY.

BEGGAR, one who begs alms.

BEGHARDI, a certain ſect of heretics, which aroſe in Germany, and in the Low Countries, about the end of the 13th century. They made profeſſion of the monaſtical life, without obſerving celibacy; and maintained, that man could become as perfect in this life, as he ſhall be in heaven; that every intellectual nature is of itſelf happy, without the ſuccour of grace; and that he who is in this ſtate of perfection ought to perform no good works, nor worſhip the hoſt.

BEGLERBEG, a governor of one of the principal governments in the Turkiſh empire. There are two ſorts of beglerbegs: The one have a certain revenue aſſigned upon the cities, boroughs, and villages of their government, which they raiſe by power of the commiſſion granted to them by the ſultan; the others have a certain rent paid by the treaſurer of the grand ſignior. They are become almoſt independent; and have under their juriſdiction ſeveral ſangiacs or particular governments, and begs, agas, and other officers who obey them.

BEGONIA, in botany, a genus of the polygamia monœcia claſs. The hermaphrodite flower has no calix; the corolla has 5 petals; it has many ſtamina, and 3 ſtyli; the male has likewiſe no calix; the corolla has 4 petals; and has a great number of ſtamina. There is but one ſpecies of begonia, *viz.* the obliqua, a native of India.

BEGUARDI, or BEGHARDI. See BEGHARDI.

BEGUINS, congregations of devout young women, who maintain themſelves by the work of their hands, leading a middle kind of life between the ſecular and religious. Theſe ſocieties conſiſt of ſeveral houſes placed together in one incloſure, with one or more churches, according to the number of beguins.

There is in every houſe a prioreſs, without whoſe leave they cannot ſtir out. Their vow is conceived in theſe terms: *I promiſe to be obedient and chaſte, as long as I continue in this beguinage.* They obſerve a three years novitiate before they take the habit, and the rector of the pariſh is their ſuperior, but can do nothing without the advice of eight beguins.

They are eſtabliſhed in ſeveral parts of Flanders.

BEHEADING, a capital puniſhment, inflicted by cutting off the head with an ax, ſword, &c.

Among the Romans, beheading was a military puniſhment, performed at firſt with an ax, but afterwards with a ſword, as done at preſent in Holland and France. In England the ax is preferred; and in Scotland they uſe, for this purpoſe, a machine called a *maiden*.

BEHEN, in botany. See CUCUBALUS.

BEJA, a city of Alentejo, in Portugal, in 8° 40′ W. long. and 37° 55′ N. lat.

BEICHLINGEN, a city of Thuringia, in the circle of Upper Saxony in Germany, in 11° 25′ E. long. and 51° 20′ N. lat.

BEILA, a town of Piedmont in Italy, about thirty-two miles north of Turin; E. long. 7° 45′, and N. lat. 45°.

BEILSTEIN, a town of the landgraviate of Heſſe in Germany, ſituated about 32 miles north of Mentz, in 8° E. long. and 50° 30′ N. lat.

BEIZA, or BEIZATH, in Hebrew antiquity, a word ſignifying an egg, was a certain meaſure in uſe among the Jews. The beiza was likewiſe a gold coin, weighing forty drachms, among the Perſians, who gave out, that Philip of Macedon owed their king Darius a thouſand beizaths or golden eggs, for tribute-money; and that Alexander the Great refuſed to pay them, ſaying, that the bird which laid theſe eggs was flown into the other world.

BELAC, a ſmall city of la Marche, in the Lyonnois; E. long. 1° 15′, and N. lat. 46° 15′.

BELAY, in the ſea-language, is to make faſt the ropes in their proper places.

BELCASTRO, a city of Calabria, in the kingdom of Naples; E. long. 17° 15′, and N. lat. 39° 15′.

BELCOE, a town of Ireland, ſituated on Loch-ninny, in the county of Farmanagh, and province of Ulſter; W. long. 8° 6′, and N. lat. 54° 5′.

BELEM, a fortreſs on the north ſide of the river Tagus, about three miles weſt of Liſbon.

BELEMNITES, in natural hiſtory, a ſubſtance concerning the nature of which there has been much diſpute. Some maintain it to be a petrified animal; others will

will have it to be a fossil, *&c.* Linnæus refers the belemnites to the class of shells with several cells. The shape of the belemnites is sometimes conical, sometimes cylindrical; and they commonly consist of a black horny kind of substance. Their length is from two to eight inches; and their diameter from the sixth part of an inch to two or three inches. The inward part consists of rays; and there is generally a cell at the large end, and a furrow running from top to bottom. Dr Plott says, that when scraped or burnt, they smell like horn. They are generally hollow about an inch deep, and filled with gravel. Their colour is various; some are ash-coloured, others bluish. They are commonly found in gravel-pits. See Plate LI. fig 21.

BELEZERO, the capital of a province of the same name, in Russia, situated on the south-east shore of the white lake; E. long. 36°, and N. lat. 60° 50′.

BELFAST, a port-town of Ireland, in the county of Antrim, and province of Ulster; W. long. 6° 15′, N. lat. 54° 38′.

BELFRY, that part of a steeple where bells are hung, or the timber frame whereby they are supported.

BELGARDEN, a town of Eastern Pomerania, in Germany, subject to Prussia; E. long. 16° 5′, and N. lat. 54°.

BELGOROD, the capital of a province of the same name, in Russia, situated almost in the middle of that empire; E. long. 37°, and N. lat. 51° 20′.

BELGOROD is also a fortified town of Bessarabia, in Turky, situated on the Black-sea, at the mouth of the river Neister; E. long. 31°, and N. lat. 46° 30′.

BELGRADE, the capital of the province of Servia, in European Turky, situated on the south side of the Danube, in E. long. 21° 20′, and N. lat. 45°. It was yielded to the Turks in 1739.

BELI *oculus*, in natural history. See OCULUS.

BELIEF, the assent of the mind to the truth of any proposition. See METAPHYSICS.

BELL, a well known machine, ranked by musicians among the musical instruments of percussion.

The metal of which a bell is made, is a composition of tin and copper, or pewter and copper; the proportion of one to the other is almost twenty pounds of pewter, or twenty-three pounds of tin, to one hundred weight of copper.

Bell-metal is prohibited to be imported, as are hawk-bells, *&c.*

The constituent parts of a bell are the body or barrel, the clapper on the inside, and the ear or cannon on which it hangs to a large beam of wood.

Diving-BELL. See PNEUMATICS.

BELL-*foundery.* See FOUNDERY.

BELL-*flower*, in botany. See CAMPANULA.

BELL-*weed*, in botany. See JACEA.

BELLADONA, in botany, the trivial name of a species of atropa. See ATROPA.

BELLCLAIRE, a town of Ireland, in the county of Sligo, and province of Connaught, about twenty-three miles south-west of Sligo; W. long. 9° 5′, and N. lat. 53° 55′.

BELLE, a town in French Flanders, about twelve miles north-east of Lisle; E. long. 2° 40′, N. lat. 50° 45′.

BELLENTS, a city of Switzerland, in 9° E. long. and 46° N. lat.

BELLESM, a town of the Orleanois in France; E. long. 40′, N. lat. 48° 30′.

BELLEY, a town of Burgundy in France, situated on the frontiers of Savoy, about sixteen miles north-west of Chamberry; E. long. 5° 20′, N. lat. 45° 40′.

BELLEVILLE, a town of the Lyonois, in France, about nineteen miles north of Lyons; E. long. 4° 45′, N. lat. 46° 8′.

BELLIDIASTRUM, in botany, a synonime of a species of doronicum. See DORONICUM.

BELLIDIOIDES, in botany, a synonime of a species of chrysanthemum. See CHRYSANTHEMUM.

BELLING *of hops* denotes their opening and expanding themselves. See HOPS.

BELLIS, or DAISY, in botany, a genus of the syngenesia polygamia superflua class. The receptacle of the bellis is naked and conical; it has no pappus; the calix is hemispherical, with squamæ of an equal size; and the seeds are oval. There are two species; *viz.* the hortensis, a native of several parts of Europe; and the perennis, or common daisy, a native of Britain. The leaves of the perennis have a subacid taste, and are recommended as vulneraries, and in asthmas and hectic fevers.

BELLEISLE, an island on the coast of Britany, in France; in 3° W. long. and 47° 20′ N. lat.

BELLISLE is also an island of America, on the coast of New Britain.

It gives name to the streights which separate Newfoundland from New Britain; in 58° W. long. and 52° N. lat.

BELLON, a distemper common in countries where they smelt lead-ore. It is attended with languor, intolerable pains and sensation of gripings in the belly, and generally costiveness.

Beasts, poultry, *&c.* as well as men, are subject to this disorder: Hence a certain space round the smelting houses is called bellon-ground, because it is dangerous for an animal to feed upon it.

BELLONARII, in Roman antiquity, the priests of Bellona, who, in honour of that goddess, used to make incisions in their body; and, after having gathered the blood in the palm of their hand, give it to those who were partakers of their mysteries.

BELLONIA, in botany, a genus of the pentandria monogynia class. The corolla is rotated; the capsule consists of one cell inclosing many seeds. There is but one species, *viz.* the aspera, a native of America.

BELLOWING, among sportsmen, denotes the noise of roes in rutting-time.

BELLOWS, a machine so contrived as to expire and inspire the air by turns, by enlarging and contracting its capacity.

This machine is used in chambers and kitchens, in forges, furnaces, and founderies, to blow up the fire: It serves also for organs and other pneumatic instruments,

ments, to give them a proper degree of air: All these are of various constructions, according to their different purposes; but in general they are composed of two flat boards, sometimes of an oval, sometimes of a triangular figure: Two or more hoops, bent according to the figure of the boards, are placed between them; a piece of leather, broad in the middle, and narrow at both ends, is nailed on the edges of the boards, which it thus unites together; as also on the hoops which separate the boards, that the leather may the easier open and fold again; a tube of iron, brass, or copper is fastened to the undermost board, and there is a valve within that covers the holes in the underboard to keep in the air.

Each pair of bellows imported is valued in the book of rates at three shillings and four pence, and pays duty $7\frac{70}{100}$*d.* whereof $6\frac{75}{100}$*d.* is drawn back on exportation. See PNEUMATICS.

BELLUNA, the capital of the Bellunese, in the dominions of Venice, about 40 miles north of Padua; in 12° 40′ E. long. and 46° 20′ N. lat.

BELLY, in anatomy, the same with what is more usually called abdomen. See p. 256.

BELOAR, a stone, otherwise called widuris. See WIDURIS.

BELOMANCY, a sort of divination by means of arrows, practised in the east, and particularly in Arabia.

Belomancy has been performed different ways, whereof one was this: Suppose a parcel of arrows, eleven or more of them being put into a bag; these were afterwards drawn out, and according as they were marked or not, they judged of future events.

BELONE, in ichthyology, the trivial name of a species of esox. See ESOX.

BELT, in the military art, a leathern girdle for sustaining the arms, *&c.* of a soldier.

BELTS, in astronomy, two zones, or girdles, surrounding the body of the planet of Jupiter, more lucid than the rest, and of unequal breadth.

BELTS, in geography, certain streights between the German ocean and the Baltic. The belts belong to the king of Denmark, who exacts a toll from all ships which pass through them, excepting those of Sweden, which are exempted.

BELTURBET, a town of Ireland, in the county of Cavan in the province of Ulster, situated upon the river Earn, about eight miles north of Cavan; in 7° 35′ W. long. and 54° 7′ N. lat.

BELTZ, the capital of a palatinate of the same name, in the province of Red Russia, in Poland; in 24° E. long. and 50° 5′ N. lat.

BELVIDERE, in the Italian architecture, *&c.* denotes either a pavilion on the top of a building, or an artificial eminence in a garden; the word literally signifying a *fine prospect.*

BELVIDERE, in geography, the capital of a province of the same name, on the western coast of the Morea, in 22° E. long. and 37° N. lat.

BEMA, in ecclesiastical antiquity, denoted the most sacred part of a church, or that where the altar stood. It was also used for the bishop's throne, as well as for the ambo. See AMBO.

BEMBER, a chain of mountains, dividing India from Tartary.

BEMSTER, a market-town of Dorsetshire, about twelves miles north-west of Dorchester, situated in 2° 50′ W. long. and 50° 45′ N. lat.

BEN. See BEHEN.

BEN *of Judea*, a name sometimes used for benzoin. See BENZOIN.

BENAVARRE, or BENHUARRI, a town of Aragon in Spain, situated in 10′ E. long. and 42° 5′ N. lat.

BENBECULA, one of the western isles of Scotland.

BENCALIS, or BANCALIS. See BANGALIS.

BENCH, or BANC, in law. See BANC.

Free BENCH signifies that estate in copyhold-lands, which the wife, being espoused a virgin, has, after the decease of her husband, for her dower, according to the custom of the manor. As to this free-bench, several manors have several customs; and in the manors of East and West Enbourne, in the county of Berks, and other parts of England, there is a custom, that when a copyhold tenant dies, the widow shall have her free-bench in all the deceased husband's lands, whilst she lives single and chaste; but if she commits incontinency, she shall forfeit her estate: Nevertheless, upon her coming into the court of the manor, riding on a black ram, and having his tail in her hand, and at the same time repeating a form of words prescribed, the steward is obliged, by the custom of the manor, to readmit her to her free-bench.

Widow's BENCH. See WIDOW.

Amiable BENCH. See AMIABLE.

BENCHERS, in the inns of court, the senior members of the society, who are invested with the government thereof.

BENCOOLEN, a town and fort on the south-west coast of Sumatra, belonging to the E. India company, from whence great quantities of pepper are imported. It is situated in 101° E. long. and 4° S. lat.

BEND, in heraldry, one of the nine honourable ordinaries, containing a third part of the field when charged, and a fifth when plain. It is sometimes, like other ordinaries, indented, ingrailed, *&c.* and is either dexter or sinister.

BEND *dexter* is formed by two lines drawn from the upper part of the shield on the right, to the lower part of the left, diagonally. It is supposed to represent a shoulder-belt, or a scarf, when worn over the shoulder. See Plate LI. fig. 11.

BEND *sinister* is that which comes from the left side of the shield to the right: This the French heralds call a *barre.*

In BEND, is when any things, borne in arms, are placed obliquely from the upper corner to the opposite lower, as the bend lies.

Parti per BEND, *Point in* BEND, *&c.* See PARTI and POINT.

BENDER, a town of Bessarabia, in European Turky, situated on the river Neister, in 29° E. long. and 46° 40′ N. lat.

BEN-

BENDERICK, a ſea-port town, ſituated on the Perſian gulf.

BENDIDIA, a feſtival, not unlike the Bacchanalia, celebrated by the Athenians in honour of Diana.

BENDING, in a general ſenſe, the reducing a ſtraight body into a curve, or giving it a crooked form.

The bending of timber-boards, *&c.* is effected by means of heat, whereby their fibres are ſo relaxed that you may bend them into any figure.

BENDING, in the ſea-language, the tying two ropes or cables together: Thus they ſay, *bend the cable*, that is, make it faſt to the ring of the anchor; *bend the ſail*, make it faſt to the yard.

BENDITTO, a town of the Mantuan in Italy, ſituated near the ſouth ſhore of the river Po, about twelve miles ſouth-eaſt of Mantua, in 11° 20′ E. long. and 45° N lat.

BENDLET, in heraldry, the ſame with cottice. See COTTICE.

BENDS, in a ſhip, the ſame with what is called wails, or wales; the outmoſt timbers of a ſhip's ſide, on which men ſet their feet in climbing up. They are reckoned from the water, and are called the firſt, ſecond, or third bend. They are the chief ſtrength of a ſhip's ſides, and have the beams, knees, and foothooks bolted to them.

BENDY, in heraldry, is the field divided into four, ſix, or more parts, diagonally, and varying in metal and colour.

The general cuſtom of England is to make an even number, but in other countries they regard it not, whether even or odd. See Plate LI. fig. 12.

Counter BENDY is uſed by the French, to expreſs what we ordinarily call bendy of ſix per bend ſiniſter, counterchanged.

Barry Bendy. See BARRY.

Paly BENDY. See PALY.

BENE, or DE BENE ESSE. See DE BENE ESSE.

BENCAPED, among ſailors. A ſhip is ſaid to be bencaped when the water does not flow high enough to bring her off the ground, out of the dock, or over the bar.

BENEDICITE, among eccleſiaſtical writers, an appellation given to the ſong of the three children in the fiery furnace, on account of its beginning with the word *benedicite*.

BENEDICTINS, in church-hiſtory, an order of monks, who profeſs to follow the rules of St. Benedict.

The benedictins, being thoſe only that are properly called monks, wear a looſe black gown, with large wide ſleeves, and a capuche, or cowl, on their heads, ending in a point behind. In the canon law, they are ſtyled black friers, from the colour of their habit.

The rules of St. Benedict, as obſerved by the Engliſh monks before the diſſolution of the monaſteries, were as follows: They were obliged to perform their devotions ſeven times in twenty four hours, the whole circle of which devotions had a reſpect to the paſſion and death of Chriſt: They were obliged always to go two and two together: Every day in lent they were obliged to faſt till ſix in the evening, and abated of their uſual time of ſleeping and eating; but they were not allowed to practiſe any voluntary auſterity without leave of their ſuperior: They never converſed in their refectory at meals, but were obliged to attend to the reading of the ſcriptures: They all ſlept in the ſame dormitory, but not two in a bed; they lay in their cloaths: For ſmall faults they were ſhut out from meals; for greater, they were debarred religious commerce, and excluded from the chapel; and as to incorrigible offenders, they were excluded from the monaſteries. Every monk had two coats, two cowls, a table-book, a knife, a needle, and a handkerchief; and the furniture of their bed was a mat, a blanket, a rug, and a pillow.

BENEDICTION, or BLESSING. The Hebrews, under this name, underſtand the preſent uſually ſent from one friend to another, as alſo the bleſſing conferred by the patriarchs, on their death-beds, upon their children.

The privilege of benediction was one of thoſe early inſtances of honour and reſpect paid to biſhops in the primitive church. The cuſtom of bowing the head to them, and receiving their bleſſings, was become univerſal. In the weſtern churches there was anciently a kind of benediction which followed the Lord's prayer; and after the communion, the people were diſmiſſed with a benediction.

BENEDICTUS, among phyſicians, an epithet given to ſeveral medicines, on account of their lenitive qualities; thus we meet with *aqua benedicta*, *benedictum laxativum*, *vinum benedictum*, &c.

BENEDITTO SACCO. See SACCO.

BENEFICE, in an eccleſiaſtical ſenſe, a church endowed with a revenue for the performance of divine ſervice; or the revenue itſelf aſſigned to an eccleſiaſtical perſon, by way of ſtipend, for the ſervice he is to do that church.

All church-preferments, except biſhoprics, are called benefices; and all benefices are, by the canoniſts, ſometimes ſtyled dignities: But we now ordinarily diſtinguiſh between benefice and dignity, applying dignity to biſhoprics, deanries, archdeaconries, and prebendaries; and benefice to parſonages, vicarages, and donatives.

Benefices are divided by the canoniſts into ſimple and ſacerdotal: In the firſt there is no obligation but to read prayers, ſing, *&c.* ſuch are canonries, chaplainſhips, chantries, *&c.*: The ſecond are charged with the cure of ſouls, or the direction and guidance of conſciences; ſuch are vicarages, rectories, *&c.*

The Romaniſts again diſtinguiſh benefices into regular and ſecular.

Regular or titular benefices are thoſe held by a religious, or a regular, who has made profeſſion of ſome religious order; ſuch are abbeys, priories, conventuals, &c.; or rather, a regular benefice is that which cannot be conferred on any but a religious, either by its foundation, by the inſtitution of ſome ſuperior, or by preſcription: For preſcription, forty years poſſeſſion by a religious makes the benefice regular.

Secular benefices are only ſuch as are to be given to ſecular prieſts, *i. e.* to ſuch as live in the world, and are

are not engaged in any monaftic order. All benefices are reputed fecular, till the contrary is made to appear. They are called fecular benefices, becaufe held by feculars; of which kind are almoft all cures.

BENEFIT *of Clergy*. See CLERGY.

BENESCHAW, the name of two towns; the one in the kingdom of Bohemia, and the other in Silefia.

BENEVENTE, a town of Leon, in Spain, fituated on the river Efta, about 40 miles fouth of the city of Leon, in 6° W. long. and 42° 10′ N. lat.

BENEVENTO, the capital of the Farther Principate, in the kingdom of Naples, about 34 miles north-eaft of the city of Naples; fituated in 15° 30′ E. long. and 41° 15′ N. lat.

BENEVOLENCE, in morals, fignifies the love of mankind in general, accompanied with a defire to promote their happinefs. See MORALS.

BENEVOLENTIA *regis habenda* is the ancient form of purchafing the king's pardon and favour, on fubmiffion, in order to be reftored to place, title, or eftate.

BENFIELD, a town of Alface, in Germany, about 15 miles fouth of Strafburg; fituated in 7° 30′ E. long. and 48° 25′ N. lat.

BENGA, one of the Molucca iflands. See MOLUCCA.

BENGAL, the moft eafterly province of the Mogul's empire, lying at the bottom of a large bay, which takes its name from this province.

It is one of the moft fertile provinces in India, being yearly overflowed by the Ganges, as Egypt is by the Nile.

BENGUELA, a kingdom upon the weftern coaft of Africa between Angola and Jaga. It is alfo the name of the capital of that kingdom.

BENJAMIN, the fame with benzoin. See BENZOIN.

BENJAR, the moft confiderable river of the ifland Borneo, which, arifing near the middle of that ifland, runs fouthwards, and falls into the great South Sea.

BENIN, the capital of a country of the fame name, on the coaft of Guinea; fituated in 5° E. long. and 7° 30′ N. lat.

BENSHEIM, a town of Germany, fituated on the eaft-fide of the river Rhine, about 10 miles eaft of Worms, in 8° 30′ E. long. and 49° 40′ N. lat.

BENTHEIM, the capital of a county of the fame name, in the circle of Weftphalia; fituated in 7° 15′ E. long. and 52° 25′ N. lat.

BENTIVOGLIO, a town in the territory of Bologna, in Italy, about 10 miles north of that city, fituated in 12° E. long. and 44° 30′ N. lat.

BENZOIN, in materia medica, a concrete refinous juice, obtained from a large tree growing naturally in both the Indies. The refin is brought from the Eaft Indies in large maffes, compofed of white and light-brown pieces, with yellowifh fpecks: It eafily breaks betwixt the hands. That which is whiteft is moft efteemed. It has very little tafte; but its fmell is very fragrant and agreeable, efpecially when heated. The principal ufe of benzoin is in perfumes, and as a cofmetic; and enters in fubftance only into one officinal compofition, the balfamum tranmaticum. But its flowers, which is a white faline concrete obtained by committing it to the fire in proper veffels, are recommended in diforders of the breaft; and in this intention they are made an ingredient in the paregoric elixir, pectoral elixir, and pills, and in the troches of fulphur.

BERAMS, a coarfe cloth, all made with cotton-thread, which comes from the Eaft Indies, and particularly from Surat.

BERAR, an inland province of India, on this fide the Ganges, lying weftward of Orixa.

BERAUN, a town of Bohemia, fituated in 14° E. long. and 50° 2′ N. lat.

BERAY, a town of Normandy, in France, fituated in 1° 20′ W. long. and 49° 6′ N. lat.

BERBERII, the PALSY, in medicine. See PALSY.

BERBERIS, in botany, a genus of the hexandria monogynia clafs. The calix confifts of fix leaves or pieces; the petals are fix, with two glands at the ungues; it has no ftylus; and the berry contains two feeds. There are two fpecies, *viz.* the vulgaris, or barberry or pipperidge-bufh, a native of Britain; and the cretica, a native of Candia. The inner bark, which is bitter, is faid to be of ufe in the jaundice. The berries, which are gratefully acid, have been given with fuccefs in bilious fluxes, and difeafes proceeding from heat, acrimony, or thinnefs of the juices.

BERCHEROIT, or BERKOITS, a weight ufed at Archangel, and in all the Ruffian dominions, to weigh fuch merchandizes as are heavy and bulky: It weighs about 364 pounds Englifh avoirdupois weight.

BERENGARIANS, a religious fect of the XIth century, which adhered to the opinion of Berengarius, who, even in thofe days, ftrenuoufly afferted, that the bread and wine in the Lord's fupper is not really and effentially, but only figuratively, changed into the body and blood of Chrift.

BERENICE, a port-town of Egypt, now called Suez.

BERENICE'S HAIR, *coma Berenices*. See COMA.

BERE-REGIS, a market-town in Dorfetfhire, about 10 miles north-eaft of Dorchefter, in 2° 20′ W. long. and 50° 40′ N. lat.

BERESOWA, a town of Mufcovy, in Samogitia, fituated upon the river Oby.

BERG, a dutchy of Weftphalia, in Germany, lying on the eaftern fhore of the river Rhine, which feparates it from Cologne.

BERG *of St. Winox*. See WINOXBERG.

BERGAMO, a town in the territories of Venice, in Italy, about 25 miles north-eaft of Milan, in 10° E. long. and 45° 40′ N. lat.

BERGAMOT, the name of a fragrant effence extracted from a fruit which is produced by ingrafting a branch of a lemon-tree upon the ftock of a bergamot-pear. It is alfo the denomination of a coarfe tapeftry, manufactured with flocks of filk, wool, cotton, hemp, ox, cow, or goats hair, and fuppofed to be invented by the people of Bergamo.

BERGAS, a town of European Turky, in Romania, in 28° E long. and 41° 17′ N. lat.

BERGEN, the capital of a province of the fame name, in Norway: It is a confiderable port-town on the German ocean, in 6° E. long. and 60° N. lat.

Bergen is alſo the name of the capital of the iſle of Rugen, on the coaſt of Pomerania, in 14° E. long. and 54° 15′ N. lat.

Bergen-op-zoom, a fortified town of Dutch Brabant, about 20 miles north of Antwerp, in 4° 5′ E. long. and 51° 30′ N. lat.

BERGERACK, a city of Guienne in France, ſituated on the river Dordonne, about 40 miles eaſt of Bourdeaux, in 20° E. long. and 44° 55′ N. lat.

BERG-GRUEN, a kind of green ochre, uſed in painting.

BERGHMOT, an aſſembly, or court, held upon a hill in Derbyſhire, for deciding controverſies among the miners.

BERGZABERN, a town of Lower Alſace, about five miles ſouth of Landau, in 8° E. long. and 49° 5′ N. lat. It is ſubject to France.

BERKSHIRE, a county in England, lying on the ſouth ſide of the river Thames, oppoſite to Oxfordſhire and Buckinghamſhire. It gives the title of earl to a branch of the Howard family.

BERLIN, the capital of the king of Pruſſia's dominions in Germany, ſituated on the river Spree, in the marquiſate of Brandenburg; in 14° E. long. and 52° 30′ N. lat.

Berlin is alſo the name of a kind of chariot, ſo called from the city of Berlin.

BERME, in fortification, a ſpace of ground left at the foot of the rampart, on the ſide next the country, deſigned to receive the ruins of the rampart, and prevent their filling up the foſſe. It is ſometimes paliſadoed, for the more ſecurity; and in Holland it is generally planted with a quick-ſet hedge. It is alſo called *liziere*, *relais*, *foreland*, *retraite*, *pais de ſouris*, &c.

BERMUDA-ISLANDS, a cluſter of very ſmall iſlands, in the Atlantic ocean, lying almoſt in the ſhape of a ſhepherd's hook, in 65° W. long. and 32° 30′ N. lat.

BERMUDIANA, in botany, a ſynonime of the ixia. See Ixia.

BERN, a town of Bohemia, about 15 miles weſt of Prague, in 14° E. long. and 50° N. lat.

Bern is alſo the name of a city and canton in Switzerland; the former being ſituated in 7° 20′ E. long. and 47° N. lat.

The Canton of Bern is by far the moſt extenſive and powerful of all Switzerland: Their government is ariſtocratical and their religion proteſtant, according to the Preſbyterian form.

BERNARDIA, in botany, a ſynonime of the adelia. See Adelia.

BERNARDINES, an order of monks, founded by Robert abbot of Moleme, and reformed by St. Bernard. They wear a white robe with a black ſcapulary; and when they officiate they are cloathed with a large gown which is all white, and hath great ſleeves, with a hood of the ſame colour.

BERNAW, the name of three towns in Germany, one in the electorate of Brandenburg, another in the biſhopric of Ratiſbon, and the third in the Upper Palatinate.

BERNBURG, a town of Anhalt, in the circle of Upper Saxony, ſituated in 12° 20′ E. long. and 51° 50′ N. lat.

BERNERA, one of the weſtern iſles of Scotland, lying in lat. 56° 48′.

BERNICOLA, in ornithology, the trivial name of a ſpecies of anas. See Anas.

BERNICLE, in zoology. Se Lepas.

BERRY. See Bacca.

Berry, in geography, a territory of the Orleanois, having Tourain on the weſt, and the Nivernois on the eaſt.

Berry-point, a cape at the entrance of Torbay in Devonſhire.

BERSELLO, or Bresello, a town of the Modeneſe, in Italy, ſituated on the river Po, about 14 miles northeaſt of Parma; in 11° E. long. and 44° 40′ N. lat.

BERTH, or Birth, among ſailors. See Birth.

BERTRAND, or St. Bertrand, a city of Gaſcony, in France, ſituated on the river Garonne, about 45 miles ſouth of Toulouſe, in 30′ E. long. and 43° 15′ N. lat.

BERVY, a ſea-port town and borough of Scotland, ſituated on the German ocean, about 22 miles ſouthweſt of Aberdeen, in 2° 5′ W. long. and 56° 50′ N. lat.

BERWICK, a borough-town on the borders of England and Scotland, ſituated on the north ſide of the river Tweed, in 1° 40′ W. long. and 55° 30′ N. lat. It ſends two members to parliament.

North-Berwick, a town of Scotland, ſituated at the entrance of the frith of Forth, about 17 miles eaſt of Edinburgh, in 2° 27′ W. long. and 56° 5′ N. lat.

BERYL, in natural hiſtory, called by our lapidaries *aqua marina*, is a pellucid gem of a bluiſh green colour, found in the Eaſt Indies and about the gold mines of Peru: We have alſo ſome from Sileſia, but what are brought from thence are oftener coloured cryſtals than real beryls; and when they are genuine, they are greatly inferior both in hardneſs and luſtre to the oriental and Peruvian kinds.

The beryl, like moſt other gems, is met with both in the pebble and columnar form, but in the latter moſt frequently. In the pebble form it uſually appears of a roundiſh but flatted figure, and commonly full of ſmall flat faces, irregularly diſpoſed. In the columnar or cryſtalline form it always conſiſts of hexangular columns, terminated by hexangular pyramids. It never receives any admixture of colour into it, nor loſes the blue and green, but has its genuine tinge in the degrees from a very deep and duſky to the paleſt imaginable of the hue of ſea-water.

The beryl, in its perfect ſtate, approaches to the hardneſs of the granet, but it is often ſofter; and its ſize is from that of a ſmall tare to that of a pea, a a horſe-bean, or even a walnut. It may be counterfeited by reducing burnt copper to an impalpable powder, and melting it with cryſtalline glaſs or calcined cryſtal, in the proportion of one dram to a pound of glaſs.

Beryl-*cryſtal*, in natural hiſtory, a ſpecies of what Dr Hill calls *ellipomacroſtyla*, or imperfect cryſtals, is of an extreme pure, clear, and equal texture, and ſcarce ever ſubject to the ſlighteſt films or blemiſhes. It is ever conſtant to the peculiarity of its figure, which is that of a long and ſlender column, remarkably tapering

ing towards the top, and very irregularly hexangular. It is of a very fine tranſparence, and naturally of a pale brown; and carries ſo evident marks of diſtinction from all brown cryſtals, that our lapidaries call it, by way of eminence, the *beryl-cryſtal*, or ſimply the *beryl*.

BES, or BESSIS, in Roman antiquity, two thirds of the as. See AS.

BES alſo denotes two thirds of the jugerum. See JUGERUM.

BESAILE, ſignifies the father of a grand-father.

BESAILE, in law, a writ that lies where the great-grandfather was ſeiſed in fee of any lands, *&c.* at the time of his death; and after his deceaſe, a ſtranger enters thereon, the ſame day, and keeps out the heir.

BESANCON, the capital of Franche Comte in France, ſituated in 6° E. long. and 47° 20′ N. lat.

BESANT, or BEZANT, a coin of pure gold, of an uncertain value, ſtruck at Byzantium, in the time of the Chriſtian emperors; from hence the gold offered by the king at the altar, is called *beſant* or *biſant*.

BESANTS, in heraldry, round pieces of gold, without any ſtamp, frequently borne in coats of arms. See Plate LI. fig. 14.

BESIERS, a city of lower Languedoc in France, about two miles north of the Mediterranean, and fifteen north-eaſt of Narbonne, in 3° E. long. and 43° 25′ N. lat.

BESLERIA, in botany, a genus of the didynamia angioſpermia claſs. The calix is divided into five parts; and the berry globular, and contains many ſeeds. The ſpecies are three, *viz.* the melittifolia, the lutea, and the criſtata, all natives of America.

BESORCH, a coin of tin, or ſome alloyed metal, current at Ormus, at the the rate of $\frac{7}{49}$ parts of a farthing ſterling.

BESSARABIA, a province of Turky in Europe, lying about the ſeveral mouths of the Danube.

BESSIS. See BES.

BESSY, one of the Molucca iſlands, ſituated in the Indian ocean, in 1° 50′ S. lat.

BESTAIL, or BESTIAL, in ancient ſtatutes, all kinds of beaſts, or cattle, eſpecially thoſe purveyed for the king's proviſion.

BESTIARII, in Roman antiquity, ſuch as fought againſt beaſts, or thoſe who were expoſed to them by ſentence of the law. There were four kinds of beſtiarii; the firſt were thoſe who made a trade of it, and fought for money; the ſecond were ſuch young men as, to ſhew their ſtrength and dexterity in managing their arms, fought againſt beaſts; the third kind was, where ſeveral beſtiarii were let looſe at once, well armed, againſt a number of beaſts; and the fourth kind were thoſe condemned to the beaſts, conſiſting either of enemies taken priſoners in war, or as being ſlaves, and guilty of ſome enormous crime; thoſe were all expoſed naked, and without defence.

BESTRICIA, a city of Tranſylvania, remarkable for the gold mines near it; it is ſituated in 22° E. long. and 48° N lat.

BETA, the beet, in botany, a genus of the pentandria digynia claſs. The calix has four leaves; it has no corolla; the ſeeds are ſhaped like kidneys, and are ſituated within the baſe of the calix. There are two ſpecies, *viz.* the maritima or ſea-beet, a native of Britain; and the vulgaris or green beet of Bauhinus, which is chiefly cultivated for culinary uſe. Decoctions of the vulgaris looſen the belly; and hence have been ranked among the emollient herbs. The juice expreſſed from the roots is a powerful errhine.

BETANCOS, a city of Gallicia in Spain, in 8° 50′ W. long. and 43° 15′ N. lat.

BETAW. See BETUE.

BETEL, or BETLE, in botany, the trivial name of a ſpecies of piper. See PIPER.

BETELFAGUI, a town of Arabia Felix, about thirty-five leagues from Mocha.

BETHLEHEM, once a flouriſhing city of Paleſtine, but now only a poor village, is ſtill much frequented, as being the place of our Saviour's birth; it is ſituated in 36° E. long. and 31° 30′ N. lat.

BETHLEHEM is alſo the name of a town of Brabant, in the Auſtrian Netherlands, about two miles north of Louvain, ſituated in 4° 35′ E. long. and 51° N. lat.

BETHLEHEMITES, in church-hiſtory, a religious order, called alſo *ſtar-bearers*, becauſe they were diſtinguiſhed by a red ſtar with five rays, which they wore on their breaſt, in memory of the ſtar that appeared to the wiſe men, and conducted them to Bethlehem.

BETHUNE, a little fortified town of Artois, in the French Netherlands, about thirteen miles north of Arras, ſituated in 2° 35′ E. long. and 50° 32′ N. lat.

BETLIS, a city in the north of Curdiſtan, ſituated on a ſteep rock, at the ſouth end of the lake Van, on the frontiers of Perſia and Turky, in 45° E. long. and and 37° 30′ N. lat.

BETONY, in botany, the Engliſh name of the betonica, and of ſeveral ſpecies of veronica. See BETONICA and VERONICA.

BETROTHMENT, among civilians, the ſame with eſpouſals.

BETUE, or BETAW, a terriory in Dutch Guelderland, between the rivers Maeſe and Lech, ſuppoſed to be the ancient Batavia.

BETULA, or BIRCH-*tree*, in botany, a genus of the monœcia tetrandria claſs. The calix of the male flower has but one trifid leaf, and incloſes three flowers; the corolla conſiſts likewiſe of one leaf cut into four ſegments. The calix of the female is trifid, and incloſes two flowers; and the feed is membranous, and alated on each ſide. The ſpecies are five, *viz.* the alba or birch-tree, a native of Britain; the nigra, and lenta, both natives of America; the nana, a native of Lapland, Ruſſia, and Sweden; and the alnus, likewiſe a native of Lapland. The bark of the alba, or common birch-tree, is a highly inflammable ſubſtance; but its medical virtues are little known. Upon boring the trunk in the the beginning of ſpring, a ſweetiſh juice iſſues forth in great quantities; one branch will bleed an Engliſh gallon or more in a day. This juice is chiefly recommended in ſcorbutic diſorders, and other

foul-

foulneſſes of the blood: Its moſt ſenſible effect is to promote the urinary diſcharge.

BEVECUM, a town of Brabant in the Auſtrian Netherlands, about ſeven miles ſouth of Louvain, ſituated in 4° 45′ E. long. and 50° 45′ N. lat.

BEVEL, among maſons, carpenters, *&c.* a kind of ſquare, one leg whereof is frequently crooked, according to the ſweep of an arch or vault. It is moveable on a centre, and ſo may be ſet to any angle.

BEVEL-*angle*, any other angle beſides thoſe of ninety or forty-five degrees. See ANGLE.

BEVELAND, the name of two iſlands, in the province of Zealand, in the United Netherlands.

The are called North and South Beveland; and lie between the eaſtern and weſtern branches of the Scheld.

BEVERLY, a borough-town of Yorkſhire, about ſeven miles north of Hull, in 12′ W. long. and 53° 50′ N. lat. It ſends two members to parliament.

BEVILE, in heraldry, a thing broken or opening like a carpenter's rule: Thus we ſay, he beareth argent, a chief bevilé, vert, by the name of *berverlis*. See Plate LI. fig. 13.

BEUTHEN, the name of two towns in Sileſia, one of which is famous for a ſilver mine.

BEWDLEY, a borough-town of Worceſterſhire, ſituated on the river Severn, about twelve miles north of Worceſter, in 2° 20′ W. long. and 52° 25′ N. lat. It ſends only one member to parliament.

BEWITS, in falconry, pieces of leather, to which a hawk's bells are faſtened, and buttoned to his legs.

BEXOQUILLO, a name ſometimes given to the white ipecacuanha.

BEY, among the Turks, ſignifies a governor of a country or town. The Turks write it *begh*, or *bek*, but pronounce it *bey*.

This word is particularly applied to a lord of a banner, whom, in the ſame language, they call *ſangiac-beg* or *bey*. Every province in Turky is divided into ſeven ſangiacs, or banners, each of which qualifies a bey; and theſe are all commanded by the governor of the province, whom they alſo call *begler-beg*, that is, lord of all the beghs or beys of the province: Theſe beys are much the ſame as bannerets were formerly in England.

BEY *of Tunis*, the ſame with the dey of Algiers, is the prince or king of that kingdom.

BEYLAN, a town of Syria, upon the road from Aleppo to Conſtantinople.

BEZANS, cotton cloths, which come from Bengal; ſome are white, and others ſtripped with ſeveral colours.

BEZANTLER, the branch of a deer's horns next below the brow-antler.

BEZOAR, in natural hiſtory, is a ſtony concretion found in the ſtomach of ſeveral animals of the goat kind. It is compoſed of concentrical coats ſurrounding each other, with a ſmall cavity in the middle, containing a bit of wood, ſtraw, hair, or the like ſubſtances.

There are two kinds of bezoar. The firſt, which is brought from Perſia and the Eaſt Indies, is found in the ſtomach of the capra bezoardica, and eſteemed by phyſicians to be the beſt. It is called *oriental bezoar*, and is of a ſhining dark-green or olive-colour, and has an even ſmooth ſurface. On removing the outer coat, that which lies underneath is likewiſe ſmooth and ſhining. It is generally leſs than a walnut.

The ſecond kind, called *occidental bezoar*, is brought from the Spaniſh Weſt Indies, has a rough ſurface, and leſs of a green colour than the oriental. It is likewiſe much heavier, more brittle, and of a looſer texture; the coats are thicker, and, on breaking, exhibits a number of ſtriæ curiouſly interwoven. The occidental is generally larger than a walnut, and ſometimes as big as a gooſe-egg.

The great value of this ſtone in Perſia and the Eaſt, and the little uſe it is found to be of in Europe, has made many ſuſpect that the true kind is never brought to us. Many of them are indeed evidently made by art. The uſual mark to diſtinguiſh its being of a good quality, is its ſtriking a deep green colour on white paper that has been rubbed with chalk. But it is of little importance to ſay much on this ſubject. The ſtone is nothing more than a morbid concretion, much of the ſame nature with the human calculus, of no ſmell or taſte, indigeſtible in the ſtomach of the animal in which it is found, and ſcarce capable of being acted upon by any of the juices of the human body; and, notwithſtanding its many boaſted virtues, it cannot be conſidered in any other light than as an abſorbent of the weakeſt kind. However, bezoar, on account of its high price, if it ſerves no other purpoſe, is of an excellent uſe in the apothecaries bill.

BEZOARDIC, an appellation given to whatever partakes of the nature of bezoar; alſo to compound medicines whereof bezoar makes an ingredient.

BIA, in commerce, a name given by the Siameſe to thoſe ſmall ſhells which are called cowries throughout almoſt all the other parts of the Eaſt Indies. See COWRIES.

BIAFAR, a kingdom of Africa in Negritia, bounded on the Weſt by the kingdom of Benin, on the north by that of Medra, and on the eaſt and ſouth by the kingdom of Mujac.

BIALOGOROD, a town of Beſſarabia, upon the Nieſter. It is likewiſe called Akerman; E. long. 32° 20′, N. lat. 46° 24′.

BIALGRODKO, the capital of the Ukraine, ſituated upon the river Pnetz.

BIARU, a cape on the north-eaſt part of the iſland of Macaſſar, in the Indian Ocean.

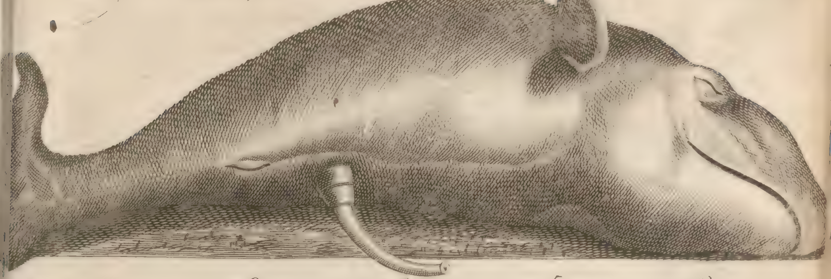
BIAS, or BIASS, in a general ſenſe, the inclination or bent of a perſon's mind to one thing more than another. It alſo ſignifies the lead or weight put into a bowl, that draws or turns the courſe of it any way to which the bias looks.

BIATHANATI, the ſame with ſuicides, or *felos de ſe*.

BIBERSBERG, a town of Upper Hungary, fifteen miles north of Preſburg; E. long. 17° 30′, and N. lat. 48° 35′.

Fig. 1. BALENA or Whale

Plate LI.



2.

3.
AZURE

4.
BARR

5.
BARR GEMELLE

6.
BARBED CROSS

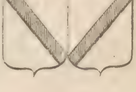
7.
BARRULY or BARRY

8.
BARRY BENDY

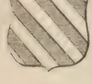
9.
BASTON

10.
BATTRING RAMS

11.
BENDS
Dexter Sinister



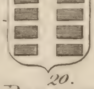
12.
BENDY



13.
BEVILE

14.
BEZANTS

15.
BILLETS



16.
BORDURE

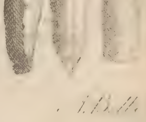
17.
BOTTONY

18.
BRACED

19.
BARONS CORONET

20.
BASALTES

21.
BELEMNITE



A. Bell. s.

BIBIO, in zoology, the trivial name of a ſpecies of tipula. See TIPULA.

BIBITORY *muſcle*, the ſame with the adductor oculi. See ADDUCTOR.

BIBLE, a name applied by Chriſtians, by way of eminence or diſtinction, to the collection of ſacred writings, or the holy ſcriptures of the Old and New Teſtament; known alſo by various other appellations, as, the Sacred Books, Holy Writ, Inſpired Writings, Scriptures, &c. The Jews ſtiled the Bible (that is, the Old Teſtament) *mikra*, which ſignifies *Leſſon*, or *Lecture*.

This collection of the ſacred writings, containing thoſe of the Old and New Teſtament, is juſtly looked upon as the foundation of the Jewiſh as well as the Chriſtian religion. The Jews, it is true, acknowledge only the ſcriptures of the Old Teſtament, the correcting and publiſhing of which is unanimouſly aſcribed, both by the Jews and Chriſtians, to Ezra. Some of the ancient fathers, on no other foundation than that fabulous and apocryphal book, the ſecond book of Eſdras, pretend, that the ſcriptures were entirely loſt and deſtroyed at the Babyloniſh captivity, and that Ezra reſtored them all again by divine revelation. What is certain is, that in the reign of Joſiah there was no other book of the law extant beſides that found in the temple by Hilkiah; from which original, by order of that pious king, copies were immediately written out, and ſearch made for all the other parts of the ſcriptures, (2 Kings xxii.); by which means copies of the whole became multiplied among the people, who carried them with them into their captivity. After the return of the Jews from the Babyloniſh captivity, Ezra got together as many copies as he could of the Sacred writings, and out of them all prepared a correct edition, diſpoſing the ſeveral books in their proper order, and ſettling the canon of ſcripture for his time. Theſe books he divided into three parts. 1. The Law. 2. The Prophets. 3. The Cetubim, or Hagiographia, i. e. *The holy writings*.

I. The Law contains, 1. Geneſis. 2. Exodus. 3. Leviticus. 4. Numbers. 5. Deuteronomy.

II The writings of the Prophets are, 1. Joſhua. 2. Judges, with Ruth. 3. Samuel. 4. Kings. 5. Iſaiah. 6. Jeremiah, with his Lamentations. 7. Ezekiel. 8. Daniel. 9. The twelve minor Prophets. 10. Job. 11. Ezra. 12. Nehemiah. 13. Eſther.

III. And the Hagiographia conſiſts of, 1. The Pſalms. 2. The Proverbs. 3. Eccleſiaſtes. 4. The Song of Solomon. This diviſion was made for the ſake of reducing the number of the ſacred books to the number of the letters in their alphabet, which amount to twenty-two. At preſent, the Jews reckon twenty-four books in their canon of ſcripture, in diſpoſing of which the law ſtands as it did in the former diviſion, and the prophets are diſtributed into the former and latter prophets.

The former prophets are,

Joſhua, Judges, Samuel, Kings.

The latter prophets are,

Iſaiah, Jeremiah, Ezekiel, and the twelve minor prophets.

And the hagiographia conſiſt of,

The Pſalms, the Proverbs, Job, the Song of Solomon, Ruth, the Lamentations, Eccleſiaſtes, Eſther, Daniel, Ezra, the Chronicles.

Under the name of Ezra, they comprehend Nehemiah. It is true this order hath not always been obſerved, but the variations from it are of little or no moment.

The five books of the law are divided into fifty-four ſections. This diviſion many of the Jews hold to have been appointed by Moſes himſelf; but others, with more probability, aſcribe it to Ezra. The deſign of this diviſion was, that one of theſe ſections might be read in their ſynagogues every ſabbath-day. The number was 54, becauſe in their intercalated years, a month being then added, there were 54 ſabbaths. In other years, they reduced them to 52, by twice joining together two ſhort ſections. Till the perſecution of Antiochus Epiphanes, they read only the law; but the reading of it being then prohibited, they ſubſtituted in the room of it 54 ſections out of the Prophets; and when the reading of the law was reſtored by the Maccabees, the ſection which was read every ſabbath out of the law, ſerved for their firſt leſſon, and the ſection out of the prophets for their ſecond. Theſe ſections were divided into verſes, of which diviſion, if Ezra was not the author, it was introduced not long after him, and ſeems to have been deſigned for the uſe of the Targumiſts, or Chaldee interpreters; for after the return of the Jews from the Babyloniſh captivity, when the Hebrew language had ceaſed to be their mother tongue, and the Chaldee grew into uſe inſtead of it, the cuſtom was, that the law ſhould be firſt read in the original Hebrew, and then interpreted to the people in the Chaldee language, for which purpoſe theſe ſhorter ſections or periods were very convenient.

The diviſion of the ſcriptures into chapters, as we at preſent have them, is of much later date. Some attribute it to Stephen Langton, archbiſhop of Canterbury, in the reigns of John and Henry III. But the true author of the invention was Hugo de Sancto Caro, commonly called Hugo Cardinalis, becauſe he was the firſt Dominican that ever was raiſed to the degree of cardinal. This Hugo flouriſhed about the year 1240. He wrote a comment on the ſcriptures, and projected the firſt concordance, which is that of the vulgar Latin Bible. The aim of this work being for the more eaſy finding out any word or paſſage in the ſcriptures, he found it neceſſary to divide the book into ſections, and the ſections into ſubdiviſions; for till that time the vulgar Latin Bibles were without any diviſion at all. Theſe ſections are the chapters into which the Bible hath ever ſince been divided. But the ſubdiviſion of the chapters was not then into verſes, as it is now. Hugo's method of ſubdividing them was by the letters A, B, C, D, E, F, G, placed in the margin at an equal diſtance from each other, according to the length of the chapters. The ſubdiviſion of the chapters into verſes, as they now ſtand in our Bibles, had its original from a famous Jewiſh rabbi, named Mordecai Nathan, about the year 1445. This rabbi, in imitation of Hugo Cardinalis, drew up a concord-

ance to the Hebrew Bible, for the ufe of the Jews. But though he followed Hugo in his divifion of the books into chapters, he refined upon his invention as to the fubdivifion, and contrived that by verfes: this being found to be a much more convenient method, it has been ever fince followed. And thus, as the Jews borrowed the divifion of the books of the holy fcriptures into chapters from the Chriftians, in like manner the Chriftians borrowed that of the chapters into verfes from the Jews.

The order and divifion of the books of the Bible, as well of the Old as the New Teftament, according to the difpofition made by the council of Trent, by decree I. feffion iv, are as follow; where we are to obferve, that thofe books to which the afterifms are prefixed, are rejected by the Proteftants, as apocryphal. See Apocrypha.

Genefis,
Exodus,
Leviticus,
Numbers,
Deuteronomy,
Jofhua,
Judges and Ruth,
1 Samuel, or 1 Kings,
2 Samuel, or 2 Kings,
1 Kings, otherwife called iii. Kings,
2 Kings, otherwife called iv. Kings.
1 Chronicles,
2 Chronicles,
1 Efdras, (as the LXX and Vulgate call it), or the book of Ezra,
2 Efdras, or (as we have it) the book of Nehemiah.
* Tobit,
* Judith,
Efther,
Job,
Pfalms,
Proverbs,
Ecclefiaftes,
Song of Solomon,
* The book of Wifdom,
* Ecclefiafticus,
Ifaiah,
Jeremiah and * Baruch,
Ezekiel,
Daniel,
Hofea,
Joel,
Amos,
Obadiah,
Nahum, which we place immediately after Micah, before Habakkuk.
Jonah, which we place immediately after Obadiah.
Micah,
Habakkuk,
Zephaniah,
Haggai,
Zechariah,
Malachi,
* 1 Maccabees,
* Maccabees.

The books of the New Teftament are,

The Gofpel of { St Matthew, St Mark, St Luke, St John,

The acts of the Apoftles.

The Epiftle of St Paul to { the Romans, the Corinthians I. the Corinthians II. the Galatians, the Ephefians, the Philippians, the Coloffians, the Theffalonians I. the Theffalonians II. Timothy, I. Timothy, II. Titus, Philemon, the Hebrews.

The general Epiftle of { St James, St Peter, I. St Peter, II. St John, I. St John, II. St John, III. St Jude,

The Revelations of St John.

The apocryphal books of the Old Teftament, according to the Romanifts, are, the book of Enoch, (fee Jude 14.) the third and fourth books of Efdras, the third and fourth books of Maccabees, the prayer of Manaffeh, the Teftament of the twelve Patriarchs, the Pfalter of Solomon, and fome other pieces of this nature.

The apocryphal books of the New Teftament are the epiftle of St Barnabas, the pretended epiftle of St Paul to the Laodiceans, feveral fpurious gofpels, Acts of the Apoftles, and Revelations; the book of Hermas, intitled the Shepherd, Jefus Chrift's Letter to Abgarus, the epiftles of St Paul to Seneca, and feveral other pieces of the like nature, as may be feen in the collection of the apocryphal writings of the New Teftament made by Fabricius.

The books which are now loft, and cited in the Old Teftament, are thefe, the book of the *Righteous*, or of Jafher, as our verfion of the Bible has it, (Jofh. x. 13. and 2 Sam. i. 18.); the book of the wars of the Lord, (Numb. xxi. 14.); the annals of the kings of Ifrael, fo often cited in the books of the Kings and Chronicles. The authors of thefe annals were the prophets, who lived in the kingdoms of Judah and Ifrael. We have likewife but a part of Solomon's three thoufand proverbs, and his thoufand and five fongs, (1 Kings iv. 32.); and we have entirely loft what he wrote upon plants, animals, birds, fifhes, and reptiles.

Ezra, in the opinion of moft learned men, publifhed the fcriptures in the Chaldee character: For that language being grown wholly into ufe among the Jews, he thought proper to change the old Hebrew character for it, which hath fince that time been retained only by the Samaritans, among whom it is preferved to this day.

Prideaux

Prideaux is of opinion that Ezra made additions in ſeveral parts of the Bible, where any thing appeared neceſſary for illuſtrating, connecting, or compleating the work; in which he appears to have been aſſiſted by the ſame ſpirit in which they were firſt written. Among ſuch additions are to be reckoned the laſt chapter of Deuteronomy, wherein Moſes ſeems to give an account of his own death and burial, and the ſucceſſion of Joſhua after him. To the ſame cauſe our learned author thinks are to be attributed many other interpolations in the Bible, which created difficulties and objections to the authenticity of the ſacred text, no ways to be ſolved without allowing them. Ezra changed the names of ſeveral places which were grown obſolete, and inſtead of them put their new names, by which they were then called, in the text. Thus it is that Abraham is ſaid to have purſued the kings who carried Lot away captive, as far as Dan; whereas that place in Moſes's time was called Laiſh; the name Dan, being unknown till the Danites, long after the death of Moſes, poſſeſſed themſelves of it.

The Jewiſh canon of ſcripture was then ſettled by Ezra, yet not ſo but that ſeveral variations have been made in it. Malachi, for inſtance, could not be put in the Bible by him, ſince that prophet is allowed to have lived after Ezra; nor could Nehemiah be there, ſince mention is made, in that book, of Jaddus, as high-prieſt, and of Darius Codomannus, as king of Perſia, who were at leaſt an hundred years later than Ezra. It may be added, that in the firſt book of Chronicles, the genealogy of the ſons of Zerubbabel is carried down for ſo many generations as muſt neceſſarily bring it to the time of Alexander, and conſequently this book could not be in the canon in Ezra's days. It is probable, the two books of Chronicles, Ezra, Nehemiah, Eſther, and Malachi, were adopted into the Bible in the time of Simon the Juſt, the laſt of the men of the great ſynagogue.

As the Jews were very backward in having any intercourſe with ſtrangers, it was a long time before their ſacred books came to be known and read in other nations. Joſephus aſcribes the little that is ſaid of the Jews by pagan writers to this, that the latter had no opportunity of being acquainted with their hiſtorians, for want of a tranſlation of their books into the Greek language. Ariſteas indeed pretends, that there was an imperfect verſion of the ſcriptures before the time of Demetrius Phalereus; and that Theopompus intending to inſert a part of them in his verſes, was deprived of his underſtanding; but of this there is no proof.

The Jews, upon their return from the Babyloniſh captivity, having brought with them their Chaldaic or Aſſyrian language, which from that time became their mother-tongue, gave birth to the Chaldee tranſlations, or rather paraphraſes of the Bible, called *Targum*. See TARGUM.

Greek BIBLE. It is a matter of diſpute among authors whether there was a Greek verſion of the Old Teſtament more ancient than the Septuagint. See SEPTUAGINT.

Before our Saviour's time, there was no other Greek verſion of the Old Teſtament, beſides that which went under the name of the Septuagint: But after the eſtabliſhment of Chriſtianity, ſome authors undertook new tranſlations, under pretence of making them more conformable to the Hebrew text. The firſt who performed this deſign was the Jewiſh proſelyte Aquila, of the city of Synope in Pontus, diſciple to Rabbi Akiba, who put it in execution the twelfth year of the emperor Adrian, A. D. 128. St Epiphanius pretends, that being excommunicated after his converſion, for addicting himſelf to judicial aſtrology, he ſet about this verſion out of hatred to the Chriſtians, and with a wicked deſign of corrupting the paſſages of the prophets relating to Jeſus Chriſt. St Jerom ſays, his verſion is made word for word, and with too ſcrupulous a nicety.

The ſecond Greek verſion after the Septuagint is that of Symmachus, a Samaritan by birth, who firſt turned Jew, then Chriſtian, and at laſt Ebionite. He compoſed it, according to Epiphanius, in the reign of the emperor Severus. His verſion was more free than the reſt; for he applied himſelf chiefly to the ſenſe, without tranſlating word for word; wherefore his verſion comes nearer the Septuagint than that of Aquila. The third Greek verſion is that of Theodotion of Epheſus. It is ſaid he was a diſciple of Marcion, and that, having had ſome difference with thoſe of his ſect, he turned Jew. The verſion of this author was the beſt of the three, becauſe he kept a juſt medium between Aquila and Symmachus, not confining himſelf ſo ſervilely to the letter as the firſt did, nor wandering ſo far from it as the ſecond did.

There were, beſides theſe, three other Greek verſions, whoſe authors are unknown.

Syriac BIBLE. The Syrians have in their language a verſion of the Old Teſtament, which they pretend to be of great antiquity. A great part of it, they ſay, was made in Solomon's time, and the reſt in the time of Abgarus king of Edeſſa. They relate, that Hiram king of Tyre deſired Solomon to communicate the uſe of letters and writing to the Syrians, and to get tranſlated for them the ſacred books of the Hebrews; which Solomon complied with, and ſent them the Pentateuch, Joſhua, Judges, Ruth, Samuel, Pſalms, Proverbs, Eccleſiaſtes, Solomon's Song, and Job, which were the only books then extant; the remaining books of ſcripture, they add, were tranſlated into Syriac after the death of Chriſt, by the care of Abgarus king of Edeſſa. But this account is looked upon as fabulous. It is true, the Syriac verſion which we have now muſt be very ancient, ſince it is often cited by the fathers. Dr Prideaux is of opinion, it was made within the firſt century; that the author of it was ſome Chriſtian of the Jewiſh nation; and that it is the beſt tranſlation of the Old Teſtament. This verſion is not always agreeable to the original; but in ſome places is more conformable to the Samaritan Pentateuch, and in ſome to the verſion of the Septuagint. In the Pſalms, the tranſlator has taken the liberty to leave out the ancient titles and inſcriptions of each pſalm, inſtead of which he gives an abſtract of the contents of each pſalm.

Latin BIBLE. It is paſt diſpute, that the Latin churches had, even in the firſt ages, a tranſlation of the Bible in their language, which being the vulgar language, and conſequently underſtood by every one, occaſioned a vaſt number of Latin verſions. Among all theſe, there was one which was generally received, and called by St Jerom the vulgar, or common tranſlation. St Auſtin

ſtin gives this verſion the name of the Italic, and prefers it to all the reſt: But we reſerve a diſtinct article for this verſion. See Vulgate.

St Jerom undertook to reviſe and correct the Latin verſion of the Bible; but, having afterwards attained to a more perfect knowledge of the Hebrew language, he ſet about a new tranſlation of ſome books of the Old Teſtament from the Hebrew; and continuing, at the ſolicitation of his friends, to tranſlate the reſt, he at laſt perfected an entire new verſion of all the books contained in the Hebrew canon. In his tranſlation, he followed, as nearly as he could, the verſion of the Septuagint, and retained the very expreſſions of the ancient vulgar Latin, as far as was conſiſtent with purity of ſtyle and true Latinity. This tranſlation was ſo highly applauded by the Chriſtian church, that ſome authors have pretended it was brought to perfection by the inſpiration of the Holy Ghoſt. But St Auguſtine looked upon the author to be ſo well ſkilled in the Hebrew language, as to be able to undertake, and bring to perfection ſuch a work by the ſtrength of his own abilities. St Jerom's verſion was ſoon received in many churches; and in the ſixth century it became as general, and in as great eſteem, as the ancient Vulgate.

It was not till the ſixteenth century that any new Latin tranſlations were made of the Bible from the Hebrew text. Sanctes Pagninus, a Dominican monk, was the firſt who undertook a new verſion of the books of ſcripture from the modern Hebrew text. His deſign was encouraged by pope Leo X.; and his verſion made its firſt appearance at Lyons in the year 1527. It adheres too ſcrupulouſly to the words of the text, which makes it obſcure, and ſavour of barbarity in many places. He is likewiſe often miſled as to the ſenſe, having affected too much to follow the explications of the Jewiſh Rabbins. It is however a very uſeful work, and very proper to explain the literal ſenſe of the Hebrew text. Arias Montanus, when he compiled the edition of the *Biblia Polyglotta*, reviſed this tranſlation of Pagninus.

Cardinal Cajetan, though not verſed in the Hebrew, undertook a tranſlation of ſome parts of the Bible by the aſſiſtance of two perſons well ſkilled in that language, the one a Jew, the other a Chriſtian. After him Iſidore Clarius, a monk of Mount Caſſin, ſet himſelf to reform the vulgar verſion of the Bible after the Hebrew text; in the doing of which he pretends to have corrected above eight thouſand paſſages of the Bible. Beſides theſe tranſlations, made by catholic authors, there are ſome likewiſe performed by proteſtant tranſlators; the firſt of whom was Sebaſtian Munſter. His verſion is more intelligible, and in much better Latin, than that of Pagninus. Huetius beſtows on him the character of a tranſlator well verſed in the Hebrew, and whoſe ſtyle is very exact and comformable to the original. The tranſlation of Leo Juda, a Zuinglian, printed at Zurich in 1543, and afterwards by Robert Stephens in 1545, is written in a more elegant ſtyle than that of Munſter; but he often departs from the literal meaning of the Hebrew text for the ſake of an elegant Latin expreſſion. However, in this he has not taken ſo great a liberty as Sebaſtian Caſtalio, who undertook to give the world an elegant Latin verſion of the Bible: But there are critics who cenſure him for departing from the noble ſimplicity and natural grandeur of the original, and deviating into an affected effeminate ſtyle, overcharged with falſe rhetoric, and not always true Latinity. The verſion of Junius and Tremellius, has much more of the true natural ſimplicity: The chief Hebraiſms are preſerved in it, and the whole is ſtrictly conformable to the Hebrew text. We muſt not forget the verſion of Theodore Beza, a proteſtant divine of Geneva, in the ſixteenth century. Sebaſtian Caſtalio found fault with this verſion, and Beza wrote an apology for it about the year 1564.

Arabic Bible. The Arabic verſions of the Bible are of two ſorts; the one done by Chriſtians, the other by Jews. There is one of the Old Teſtament, whoſe author is ſuppoſed to be Saadias Gaon, a Jew of Babylon, who wrote the ſame about the year of Chriſt 900. Of this whole work the Pentateuch alone is printed. The Jews have another Arabic verſion in Hebrew characters, which Erpenius publiſhed in Arabic characters at Leyden in the year 1622. Among the Arabic tranſlations done by Chriſtians, there is one printed in the polyglots of Paris and London; but both the author, and the time when it was written, are unknown. It muſt have been made ſince the publication of the Koran, becauſe the author, in many places, has evidently followed it. In this verſion the Pentateuch is tranſlated from the Hebrew text; Job, from the Syriac; and the reſt from the Septuagint, and two other verſions of the Pentateuch, the manuſcripts of which are in the Bodleian library. There are alſo ſome Arabic tranſlations of the Pſalms; one printed at Genoa in 1516, the other at Rome in 1619: And there is a manuſcript verſion of the prophets in this language preſerved in the Bodleian library.

The goſpel being preached in all nations, there is no doubt, but that the Bible, which is the foundation of the Chriſtian religion, was tranſlated into the reſpective languages of each nation. St Chryſoſtom and Theodoret both teſtify, that the books of the Old and New Teſtament had been tranſlated into the Syrian, Egyptian, Indian, Perſian, Armenian, Æthiopic, Scythian, and Samaritan languages. Socrates and Sozomen tell us, that Ulphilas biſhop of the Goths, who lived about the middle of the fourth century, had tranſlated the holy ſcriptures into the Gothic language; and pope John VIII. gave his approbation to the verſion of the holy ſcriptures made into the Sclavonian.

Æthiopic Bible. The Æthiopic verſion of the Old Teſtament is made immediately from the Greek text of the Septuagint; and there is a very plain agreement between this tranſlation and the Alexandrian manuſcript: The order of the chapters, the inſcriptions of the Pſalms, and every thing elſe being exactly alike. The Æthiopians attribute this verſion to Frumentius, the apoſtle of Æthiopia, ſent thither by Athanaſius biſhop of Alexandria.

Coptic or *Egyptian* Bible. The Coptic or Egyptian tranſlation is likewiſe made from the Greek of the Septuagint, in which the Egyptian tranſlator ſo punctually followed the Greek text, that he refuſed to make uſe of the labours of Origen and others, who had been at the pains

pains to compare the Greek verſion with the Hebrew text. We are quite in the dark as to the author and the time of this verſion, but probably it is very ancient, ſince we cannot ſuppoſe the Egyptian church was long without a tranſlation of the ſcriptures in their mother tongue.

Perſian and Turkiſh BIBLE. There are ſeveral verſions of the Bible in the Perſian language, moſt of which are in manuſcript. There is a tranſlation of the Pſalms by one father John, a Carmelite; and another of the ſame book done from the Latin by the Jeſuits. Walton, in the London Polyglott, has publiſhed the Goſpels, tranſlated by one Simon the ſon of Joſeph, a Chriſtian of Perſia, who lived in the year 1341. We have likewiſe ſome manuſcript tranſlations of the Bible in the Turkiſh language, particularly a verſion of the New Teſtament printed at London in the year 1666.

Armenian and Georgian BIBLE. The Armenians have an old tranſlation of the ſcriptures in their language, taken from the Greek of the Septuagint. Three learned Armenians were employed about it, in the time of the emperor Arcadius, *viz.* Moſes ſirnamed the Grammarian, David the Philoſopher, and Mampræus. The Armenians, in 1666, procured an edition of the Bible in their language to be made at Amſterdam, under the direction of an Armenian biſhop. Another was printed at Antwerp in 1670, by the procurement of Theodorus Patræus, and the New Teſtament ſeparately in 1668.

The Georgians have likewiſe a tranſlation of the Bible in the old Georgian language: But as this language is known only to a very few perſons, and the people of the country are extremely ignorant, there is ſcarce any one who either reads or underſtands this verſion.

Whilſt the Roman empire ſubſiſted in Europe, the reading of the ſcriptures in the Latin tongne, which was the univerſal language of that empire, prevailed every where. But ſince the face of affairs in Europe has been changed, and ſo many different monarchies erected upon the ruins of the Roman empire, the Latin tongue has by degrees grown into diſuſe; whence has ariſen a neceſſity of tranſlating the Bible into the reſpective languages of each people; and this has produced as many different verſions of the ſcriptures in the modern languages, as there are different nations profeſſing the Chriſtian religion. Hence we meet with French, Italian, Spaniſh, German, Flemiſh, Daniſh, Sclavonian, Poliſh, Bohemian, and Ruſſian or Muſcovite Bibles; beſides the Anglo-Saxon and modern Engliſh and Iriſh Bibles.

French BIBLE. The oldeſt French Bible we hear of is the verſion of Peter de Vaux, chief of the Waldenſes, who lived about the year 1160. Raoul de Preſle tranſlated the Bible into French in the reign of Charles V. king of France, about the year 1380. Beſides theſe, there are ſeveral old French tranſlations of particular parts of the ſcripture. The doctors of Louvain publiſhed the Bible in French at Louvain, by order of the emperor Charles V. in 1550. There is a verſion by Iſaac le Maitre de Sacy, publiſhed in 1672, with explanations of the literal and ſpiritual meaning of the text, which was received with wonderful applauſe, and has been often reprinted. As to the New Teſtaments in French, which have been printed ſeparately, one of the moſt remarkable is that of F. Amelotte of the oratory, compoſed by the direction of ſome French prelates, and printed with annotations in the year 1666, 1667, and 1670. The author pretends he had been at the pains to ſearch all the libraries in Europe, and collate the oldeſt manuſcripts. But, in examining his work, it appears that he has produced no conſiderable various readings, which had not before been taken notice of either in the London Polyglott or elſewhere. The New Teſtament of Mons printed in 1665, with the archbiſhop of Cambray's permiſſion, and the king of Spain's licence, made a great noiſe in the world. It was condemned by pope Clément IX. in 1668, and by pope Innocent XI. in 1679, and in ſeveral biſhoprics of France at ſeveral times. The New Teſtament publiſhed at Trevoux in 1702, by M. Simon, with literal and critical annotations upon difficult paſſages, was condemned by the biſhops of Paris and Meaux in 1702. F. Bohours, a Jeſuit, with the aſſiſtance of F. F. Michael Tellier, and Peter Bernier, Jeſuits likewiſe, publiſhed a tranſlation of the New Teſtament in 1697: But this tranſlation is, for the moſt part, harſh and obſcure, which was owing to the author's keeping too ſtrictly to the Latin text from which he tranſlated.

There are likewiſe French tranſlations publiſhed by Proteſtant authors; one by Robert Peter Olivetan, printed at Geneva in 1535, and ſince often reprinted with the corrections of John Calvin and others; another by Sebaſtian Caſtalio, remarkable for particular ways of expreſſion never uſed by good judges of the language. John Diodati likewiſe publiſhed a French Bible at Geneva in 1644; but ſome find fault with his method, in that he rather paraphraſes the text than tranſlates it. Faber Stapalenſis tranſlated the New Teſtament into French, which was reviſed and accommodated to the uſe of the reformed churches in Piedmont, and printed in 1534. Laſtly, M. John Le Clerc publiſhed a New Teſtament in French at Amſterdam in 1703, with annotations taken chiefly from Grotius and Hammond; but the uſe of this verſion was prohibited in Holland by order of the States-General, as tending to revive the errors of Sabellius and Socinus.

Italian BIBLE. The firſt Italian Bible publiſhed by the Romaniſts, is that of Nicolas Malerme, a Benedictine monk, printed at Venice in 1471. It was tranſlated from the Vulgate. The verſion of Anthony Brucioli, publiſhed at Venice in 1532, was prohibited by the council of Trent. The Calviniſts likewiſe have their Italian Bibles. There is one of John Diodati in 1607 and 1641, and another of Maximus Theophilus in 1551, dedicated to Francis de Medicis duke of Tuſcany. The Jews of Italy have no entire verſion of the Bible in Italian; the inquiſition conſtantly refuſing to allow them the liberty of printing one.

Spaniſh BIBLE. The firſt Spaniſh Bible that we hear of, is that mentioned by Cyprian de Valera, which he ſays was publiſhed about the year 1500. The Epiſtles and Goſpels were publiſhed in that language by Ambroſe de Monteſin in 1512; the whole Bible by Caſſiodore de Reyna, a Calviniſt, in 1569; and the New Teſtament, dedicated

dedicated to the emperor Charles V. by Francis Enzinas, otherwife called Driander, in 1543. The firft Bible which was printed in Spanifh for the ufe of the Jews, was that printed at Ferrara in 1553, in Gothic characters, and dedicated to Hercules d'Eft duke of Ferrara. This verfion is very ancient, and was probably in ufe among the Jews of Spain before Ferdinand and Ifabella expelled them out of their dominions in 1492.

German Bible. The firft and moft ancient tranflation of the Bible in the German language, is that of Ulphilas bifhop of the Goths, about the year 360. This bifhop left out the books of Kings, which treat chiefly of war, left it fhould too much encourage the martial humour of the Goths. An imperfect manufcript of this verfion was found in the abbey of Verden near Cologn, written in letters of filver, for which reafon it is called *Codex Argenteus*; and it was publifhed by Francis Junius in 1665. The oldeft German printed Bible extant, is that of Nuremberg, printed in 1447; but who the author of it was, is uncertain. John Emzer, chaplain to George duke of Saxony, publifhed a verfion of the New Teftament in oppofition to Luther. There is a German Bible of John Eckius in 1537, with Emzer's New Teftament added to it; and one by Ulembergius of Weftphalia, procured by Ferdinand duke of Bavaria, and printed in 1630. Martin Luther, having employed eleven years in tranflating the Old and New Teftament, publifhed the Pentateuch in 1522, the hiftorical books and the Pfalms in 1524, the books of Solomon in 1527, Ifaiah in 1529, the Prophets in 1531, and the other books in 1530: He publifhed the New Teftament in 1522. The learned agree, that his language is pure, and the verfion clear, and free from intricacies: It was revifed by feveral perfons of quality, who were mafters of all the delicacies of the German language. The German Bibles which have been printed in Saxony, Switzerland, and elfewhere, are for the moft part the fame as that of Luther, with very little variation. In 1604, John Pifcator publifhed a verfion of the Bible in German, taken from that of Junius and Tremellius: But his turn of expreffion is purely Latin, and not at all agreeable to the genius of the German language: The Anabaptifts have a German Bible printed at Worms in 1529. John Crellius publifhed his verfion of the New Teftament at Racovia in 1630; and Felbinger his, at Amfterdam, in 1660.

Flemifh Bible. The Flemifh Bibles of the Romanifts are very numerous, and for the moft part have no author's name prefixed to them, till that of Nicolas Vinck, printed at Lovain in 1548. The Flemifh verfions made ufe of by the Calvinifts till the year 1637, were copied principally from that of Luther. But the fynod of Dort having in 1618 appointed a new tranflation of the Bible into Flemifh, deputies were named for the work, which was not finifhed till the year 1637.

Danifh Bible. The firft Danifh Bible was publifhed by Peter Palladius, Olaus Chryfoftom, John Synningius, and John Maccabæus, in 1550, in which they followed Luther's firft German verfion. There are two other verfions, the one by John Paul Refenius bifhop of Zealand, in 1605; the other, being the New Teftament only, by John Michel, in 1524.

Swedifh Bible. In 1534 Olaus and Laurence publifhed a Swedifh Bible from the German verfion of Martin Luther. It was revifed in 1617, by order of king Guftavus Adolphus, and was afterwards almoft univerfally followed.

Bohemian, Polifh, Ruffian or Mufcovite, and Sclavonian Bibles. The Bohemians have a Bible tranflated by eight of their doctors, whom they had fent to the fchools of Wittemberg and Bafil, on purpofe to ftudy the original languages. It was printed in Moravia in the year 1539. The firft Polifh verfion of the Bible, it is faid, was that compofed by Hadewich wife of Jagellon, duke of Lithuania, who embraced Chriftianity in the year 1390. In 1599, there was a Polifh tranflation of the Bible publifhed at Cracow, which was the work of feveral Divines of that nation, and in which James Wieck, a Jefuit, had a principal fhare. The Proteftants, in 1596, publifhed a Polifh Bible from Luther's German verfion, and dedicated it to Uladiflaus IV. king of Poland. The Ruffians or Mufcovites publifhed the Bible in their language in 1581. It was tranflated from the Greek by St Cyril, the apoftle of the Sclavonians; but this old verfion being too obfcure, Erneft Gliik, who had been carried prifoner to Mofcow after the taking of Narva, undertook a new tranflation of the Bible in the Sclavonian; who dying in 1705, the Czar Peter appointed fome particular divines to finifh the tranflation: But whether it was ever printed, we cannot fay.

Englifh-Saxon, and modern Englifh Bibles. If we inquire into the verfions of the Bible of our own country, we fhall find that Adelm bifhop of Sherburn, who lived in 709, made an Englifh-Saxon verfion of the Pfalms; and that Eadfrid, or Ecbert, bifhop of Lindisferne, who lived about the year 730, tranflated feveral of the books of fcripture into the fame language. It is faid likewife, that venerable Bede, who died in 785, tranflated the whole Bible into Saxon. But Cuthbert, Bede's difciple, in the enumeration of his mafter's works, fpeaks only of his tranflation of the Gofpel; and fays nothing of the reft of the Bible. Some pretend, that king Alfred, who lived in 890, tranflated a great part of the fcriptures. We find an old verfion in the Anglo-Saxon of feveral books of the Bible, made by Elfric abbot of Malmefbury: It was publifhed at Oxford, in 1699. There is an old Anglo-Saxon verfion of the four Gofpels, publifhed by Matthew Parker, archbifhop of Canterbury, in 1571, the author whereof is unknown. Dr Mill obferves, that this verfion was made from a Latin copy of the old Vulgate.

As to the Englifh verfions of the Bible, the moft ancient is that of John de Trevifa, a fecular prieft, who tranflated the Old and New Teftament into Englifh, at the requeft of Thomas lord Berkley: He lived in the reign of Richard II. and finifhed his tranflation in the year 1357. The fecond author, who undertook this work, was the famous Wickliff, who lived in the reigns of Edward III. and Richard II. The manufcript of his verfion is in feveral libraries in England. In the year 1534, an Englifh verfion of the Bible, done partly by William Tindal, and partly by Miles Coverdale, was brought

brought into England from Antwerp. The bifhops found great fault with this tranflation; upon which a motion was made in convocation for an Englifh tranflation of the Bible to be fet up in all churches. This motion, though oppofed by bifhop Gardiner and his party, fucceeded at laft. The king gave orders for fetting about it with all poffible hafte, and within three years the impreffion of it was finifhed. Cromwell procured a general warrant from the king, allowing all his fubjects to read it; for which Cranmer wrote his thanks to Cromwell, ' rejoicing to ' fee the work of reformation now rifen in England, ' fince the word of God did now fhine over it all without ' a cloud.' Cromwell likewife gave out injuctions, requiring the clergy to fet up Bibles in all their churches, and to encourage the people to read them. In 1542, an act paffed for reftraining the ufe of the Bible. The preamble fets forth, that ' many feditious and ignorant ' people had abufed the liberty granted them for reading ' the Bible; and that great diverfity of opinions, animo- ' fities, tumults, and fchifms had been occafioned by ' perverting the fenfe of the fcripture. To retrieve the ' mifchiefs arifing from hence, it is enacted, that a cer- ' tain form of orthodox doctrine be fet forth, as a ftan- ' dard of belief; and that Tindal's *falfe tranflation* of ' the Old and New Teftament be fuppreffed, and for- ' bidden to be read in any of the king's dominions.' In the reign of Edward VI. Fuller mentions another tranflation of the Bible, printed in two editions; the firft in 1549, the other in 1551, but neither of them divided into verfes.

In the reign of queen Elizabeth came out the Bifhops Bible, fo called, becaufe feveral of that order were concerned in that verfion. The work was divided into feveral parcels, and affigned to men of learning and character. Moft of the divifions are marked with great initial letters, fignifying either the name or the titles of the perfons employed. Archbifhop Parker had the principal direction of this affair; he revifed the performance, and perhaps put the finifhing hand to it. He likewife employed feveral critics in the Hebrew and Greek languages, to review the old tranflation, and compare it with the original.

The laft Englifh Bible is that called King James's Bible, which proceeded from the Hampton-court conference in 1603, where many exceptions being made to the Bifhops Bible, king James gave orders for a new one, not, as the preface expreffes it, for a tranflation altogether new, nor yet to make of a bad one a good one, but to make a good one better; or of many good ones, one beft. Fifty-four learned perfons were appointed for this office by the king, as appears by his letter to the archbifhop, dated in 1604, which being three years before the tranflation was entered upon, it is probable feven of them were either dead, or had declined the tafk, fince Fuller's lift of the tranflators makes but forty-feven, who, being ranged under fix divifions, entered on their province in 1607. It was publifhed in 1610, with a dedication to king James, and a learned preface, and is commonly called king James's Bible. After this all other verfions dropped, and fell into difufe, except the Epiftles and Gofpels in the Common-prayer book, which were ftill contiuued, according to the bifhops tranflation, till the alteration of the Liturgy in 1661, and the Pfalms and hymns, which are to this day continued as in the old verfion.

The judicious Selden, in his Table-Talk, fpeaking of the Bible, fays, ' The Englifh tranflation of the ' Bible is the beft tranflation in the world, and ren- ' ders the fenfe of the original beft, taking in for the ' Englifh tranflation the bifhops Bible, as well as king ' James's. The tranflators in king James's time took ' an excellent way. That part of the Bible was given ' to him who was moft excellent in fuch a tongue, (as ' the Apocrypha to Andrew Downs) and then they ' met together, and one read the tranflation, the reft ' holding in their hands fome Bible either of the learn- ' ed tongues, or French, Spanifh, Italian, *&c.* If ' they found any fault, they fpoke; if not, he read on.'

King James's Bible is that now read by authority in all the churches in England.

Irifh Bible. Towards the middle of the fixteenth century, Bedell, bifhop of Kilmore, fet on foot a tranflation of the Old Teftament into the Irifh language; the New Teftament and the Liturgy having been before tranflated into that language. The bifhop appointed one King to execute this work, who, not underftanding the oriental languages, was obliged to tranflate it from the Englifh. This work was received by Bedell, who, after having compared the Irifh tranflation with the Englifh, compared the latter with the Hebrew, the LXX. and the Italian verfion of Diodati. When this work was finifhed, the bifhop would have been himfelf at the charge of the impreffion, but his defign was ftopped upon advice given to the lord-lieutenant and the archbifhop of Canterbury, that it would prove a fhameful thing for a nation to publifh a Bible tranflated by fuch a defpicable hand as King. However, the manufcript was not loft, for it went to prefs in the year 1685.

BIBLIOTHECA, in its original and proper fenfe, denotes a library, or place for repofiting books.

Bibliotheca, in matters of literature, denotes a treatife, giving an account of all the writers on a certain fubject: Thus, we have bibliothecas of theology, law, philofophy, *&c.*

There are likewife univerfal bibliothecas, which treat indifferently of all kinds of books; alfo felect bibliothecas, which give an account of none but authors of reputation.

BIBLISTS, fo the Roman-catholics call thofe Chriftians that make fcripture the fole rule of faith; in which fenfe, all proteftants either are, or ought to be, biblifts.

BIBRACH, an imperial city of Swabia in Germany, about twenty miles fouth-weft of Ulm; E. long. 9° 30′, and N. lat. 48° 12′.

BICANER, a city of Afia, in the country of the Mogul, upon the Ganges. It is the capital of the province of Baear; E. long. 87° 20′, N. lat. 28° 40′.

BICAUDA, in ichthyology, a name given to the xiphias, or fword-fifh. See Xiphias.

BICE,

BICE, or BISE, among painters, a blue colour prepared from the lapis armenus.

Bice bears the best body of all bright blues used in common work, as houſe-painting, *&c.* but it is the paleſt in colour. It works indifferently well, but inclines a little to ſandy, and therefore requires good grinding. Next to ultramarine, which is too dear to be uſed in common work, it lies beſt near the eye of all other blues.

BICEPS, in anatomy, the name of ſeveral muſcles: As the biceps humeri, or cubiti, biceps tibiæ, *&c.*

BICHET, a quantity, or meaſure of corn, which differs according to the places where it is uſed. The bichet is not a wooden meaſure, as the minot at Paris, or the buſhel at London, but is compounded of ſeveral certain meaſures. It is uſed in many parts of France, *&c.*

BICHET, a certain quantity of land, namely, as much as may be ſown by a bichet of corn.

BICKERN, the beak-iron of an anvil. See the article ANVIL.

BICLINIUM, in Roman antiquity, a chamber with two beds in it; or when two beds only were round a table. See TABLE.

BICORNIS, in anatomy, a name for the os hyoides. See HYOIDES.

BICORNIS *muſculus*, a name for the extenſor carpi radialis.

BIDDING *of the banns*, the ſame with what is otherwiſe called *aſking*. See MARRIAGE.

BIDDING, in a commercial ſenſe, the offering a ſum of money, or a certain price, for any ware or merchandize; and when any thing is ſold by auction, a perſon who has a mind to have it, muſt offer ſomething more for it than the perſon who bade laſt.

BIDDER, he that bids money for any merchandize that is ſelling by auction: The beſt, or laſt bidder, is he who offers moſt money for it. See SALE.

BIDENS, in botany, a genus of the ſyngeneſia polygamia æqualis claſs. The receptacle is paleaceous; the pappus has erect ſcabrous awns; and the calix is imbricated. There are thirteen ſpecies, only three of which, *viz.* the tripartita or trifid water-hemp agrimony, the cornua or whole-leaved water-hemp agrimony, and the minima or leaſt water-hemp agrimony, are natives of Britain. The leaves of the bidens are recommended for ſtrengthening the tone of the viſcera, and as an aperient; and ſaid to have excellent effects in the dropſy, jaundice, cahexies, and ſcorbutic diſorders.

BIDENTAL, in Roman antiquity, a place blaſted with lightning, which was immediately conſecrated by an haruſpex, with the ſacrifice of a bidens. This place was afterwards accounted ſacred, and it was unlawful to enter it, or to tread upon it; for which reaſon it was commonly ſurrounded with a ditch, wall, hedge, ropes, *&c.* See the next article.

BIDENTALES, in Roman antiquity, prieſts inſtituted to perform certain ceremonies and expiations when thunder fell on any place. Their principal office was the ſacrificing a ſheep of two years old, which, in Latin, is called *bidens*; from whence the place ſtruck with thunder got the name of *bidental*.

BIDON, a liquid meaſure, containing about five pints of Paris, that is, about five quarts Engliſh wine-meaſure. It is ſeldom uſed but among ſhips crews.

BIEL, a town of the canton of Bern in Switzerland, ſituated at the north-end of a lake to which it gives name, about fifteen miles north-weſt of the city of Bern, in 7° E. long. 47° 15′ N. lat.

BIELSKI, a town of Polachia in Poland, about ſixty-two miles ſouth of Grodno; E. long. 24°, and N. lat. 53°.

BIELSKI, or BIHELA, is alſo a town of Smolenſko, in Ruſſia; E. long. 35°, and N. lat. 56° 40′.

BIER, a wooden machine for carrying the bodies of the dead to be buried. See BURIAL.

BIENNE, in geography. See BIEL.

BIGA, in antiquity, a chariot drawn by two horſes abreaſt. Chariot-races, with two horſes, were introduced into the Olympic games in the 93d Olympiad: But the invention was much more ancient, as we find that the heroes in the Iliad fight from chariots of that kind.

BIGAMY, the poſſeſſion of two huſbands or two wives at the ſame time. See SCOTS LAW, tit. *Crimes*.

BIGEN, the name of a kingdom and city in Japon, in the iſland Niphon.

BIGGLESWADE, a market-town in Bedfordſhire, ſituated on the river Ivel, about eight miles ſouth-eaſt of Bedford; W. long. 20′, N. lat. 52° 5′.

BIGHT, among ſeamen, denotes one roll, or round, of a cable or rope, when quoiled up.

BIGNESS, or MAGNITUDE. See MAGNITUDE.

BIGNONIA, in botany, a genus of the didynamia angioſpermia claſs. The calix conſiſts of five ſegments, and is ſhaped like a cup; the faux of the corolla is bell-ſhaped, and divided into five ſegments; the pod has two cells, and the ſeeds are membranaceous, and alated. The ſpecies are ſeventeen, all natives of America and the Indies.

BIGOREE, the ſouth diviſion of the province of Gaſcony, in France.

BIGOT, a perſon fooliſhly obſtinate and perverſely wedded to any opinion, but particularly an opinion of a religious nature.

BILANDER, a ſmall flat-bottomed veſſel, with only one large maſt and ſail, and its deck raiſed half a foot above the plat-board.

BILATERAL, in a general ſenſe, denotes ſomething with two ſides. Hence,

BILATERAL COGNATION, is kinſhip both by the father and mother ſide.

BILAWS. See BY-LAWS.

BILBOA, the capital of the province of Biſcay, in Spain, ſituated near the mouth of the river Ibaicabal, which, falling into the ſea a little below it, forms a good harbour; in 3° W. long. and 43° 30′ N. lat.

BILBOWS, a puniſhment at ſea, anſwering to the ſtocks at land. The offender is laid in irons, or ſtocks, which are more or leſs ponderous according to the quality of the offence of which he is guilty.

BILDESTON, a market-town of Suffolk, about ten miles south-east of Bury, E. long 40′, and N. lat. 52° 20′.

BILDGE of a ship, the bottom of her floor, or the breadth of the place the ship rests on when she is aground. Therefore, bildge-water is that which lies on her floor, and cannot go to the well of the pump: And bildge-pumps, or burr-pumps, are those that carry off the bildge-water. They likewise say the ship is bildged, when she has some of her timber struck off on a rock or anchor, and springs a leak.

BILE, a yellow, bitter juice, separated from the blood in the liver, collected in the porus bilarius and gall-bladder, and thence discharged by the common duct into the duodenum.

The bile is properly of two kinds, and is distinguished by the names of *cystic* and *hepatic*. The hepatic bile is thin, almost insipid, and scarce coloured; the cystic bile is thicker, more coloured, and very bitter. See ANATOMY, p. 265.

BILEDULGERID, one of the divisions of Africa, having Barbary on the north, and Zaara or the Desart on the south.

BILEVEST, a town of Westphalia, in Germany, about seven miles south-east of Ravensburg, E. long. 8° 15′, N. lat. 52°. It is subject to the king of Prussia.

BILGE. See BILDGE.

BILIARY *ducts*. See ANATOMY, p. 265.

BILIMBI, in botany, a synonime of the averrhoa. See AVERRHOA.

BILINGUIS, in a general sense, signifies one that speaks two languages; but in law, is used for a jury that passes in any case between an Englishman and a foreigner, whereof part ought to be English, and part strangers.

BILOUS, in general, donotes something belonging to, or partaking of, the nature of bile. Hence,

BILIOUS *fevers* are those occasioned by the over-copiousness, or bad qualities of the bile. See MEDICINE, *Of fevers*.

BILIOUS *colic*. See MEDICINE, *Of colics*.

BILL, an instrument made of iron, edged in the form of a crescent, and adapted to a handle. It is used by plumbers, to perform several parts of their work; by basket-makers, to cut the largest pieces of chesnut-trees and other wood; and by gardeners, to prune trees. When short, it is called a *hand-bill*, and when long, a *hedge-bill*.

BILL, in Scots law, has two general significations: Every summary application in writing, by way of petition, to the court of session, is called a *bill*. But the word more commonly denotes a short obligation or mandate, by which one person obliges himself to pay a sum of money to another, or his order, against a certain time; or by which one person draws upon another for a sum payable to a third person: By this last kind of bill, money-matters are commonly transacted betwixt the inhabitants of different countries, and is called a *bill of exchange*: When the parties concerned live in Scotland, it is termed an *inland bill*. As to the solemnities of bills, methods of negotiating them, their legal privileges, &c. See SCOTS LAW, tit. *Obligations by word and writ*.

BILL signifies also a paper, either written or printed, in very large characters, which is posted up in some open and public place, to give notice of the sale of any merchandize, or ship, or of the sailing of any vessel into foreign parts.

BILL *in trade*, both wholesale and retail, as also among workmen, signifies an account of merchandizes or goods delivered to a person, or of work done for one.

Settled BILL, a bill, at the bottom of which they to whom the goods are delivered acknowledge that they have received them; that they are satisfied with the price, and promise to pay it.

BILL *of credit*, that which a merchant or banker gives to a person whom he can trust, impowering him to receive money from his correspondents in foreign countries.

BILL *of entry*, an account of the goods entered at the custom house, both inwards and outwards. In this bill must be expressed, the merchant exporting or importing; the quantity of merchandize, and the divers species thereof; and whither transported, or from whence.

BILL *of lading*, an acknowledgment signed by the master of a ship, and given to a merchant, &c. containing an account of the goods which the master has received on board from that merchant, &c. with a promise to deliver them at an intended place for a certain salary. Each bill of lading must be treble, one for the merchant who loads the goods, another to be sent to the person to whom they are consigned, and the third to remain in the hands of the master of the ship. It must be observed, however, that a bill of lading is used only when the goods, sent on board a ship, are but part of the cargo: For when a merchant loads a whole vessel for his own personal account, the deed passed between him and the master of the ship is called *charter-party*. See CHARTER-*party*.

BILL *of parcels*, an account given by the seller to the buyer, containing the particulars of all the sorts and prices of the goods bought.

BILL *of sale*, is when a person wanting a sum of money, delivers goods as a security to the lender, to whom he gives this bill, impowering him to sell the goods, in case the sum borrowed is not repaid, with interest, at the appointed time.

BILL *of store*, a licence granted at the custom-house to merchants, by which they have liberty to carry, custom-free, all such stores and provisions as they may have occasion for during their voyage.

BILL *of sufferance*, a licence granted to a merchant, at the custom-house, suffering him to trade from one English port to another, without paying custom.

Bank-BILL, a private instrument whereby private persons become intitled to a part in the bank-stock. See BANK.

BILL denotes also a declaration in writing, expressing either some wrong the complainant has suffered by the defendant, or else a fault that the party complained of has committed against some law or statute of the realm.

This bill is ſometimes exhibited to juſtices at the general aſſizes, by way of indictment, or referred to others having juriſdiction; but more eſpecially is addreſſed to the lord-chancellor, for inconſcionable wrongs done. It contains the thing or fact complained of, the damage ſuſtained, and a petition or proceſs againſt the defendant for redreſs; and is uſed both in criminal and civil caſes. In a criminal caſe, the words

Billa *vera* are indorſed by the grand jury upon a preſentment, thereby ſignifying, that they find the ſame made with probable evidence, and on that account worthy of farther conſideration.

Bill *in parliament*, a paper containing propoſitions offered to the houſes to be paſſed by them, and then preſented to the king to paſs into a law.

Bill *of attainder*. See Attainder.

Bill *of appeal*. See Appeal.

Bill *of mortality*. See Mortality.

BILLARD, a name given, in ſome parts of the kingdom, to the young fiſh of the gadus-kind. See Gadus.

BILLERECA, a market-town of Eſſex, about twenty miles eaſt of London, in E. long. 20′, and N. lat. 51° 35′.

BILLET, in heraldry, a bearing in form of a long ſquare. They are ſuppoſed to repreſent pieces of cloth of gold or ſilver; but Guillim thinks they repreſent a letter ſealed up; and other authors take them for bricks.

Billeté ſignifies that the eſcutcheon is all over-ſtrewed with billets, the number not aſcertained. See Plate LI. fig. 15.

Billet-*wood*, ſmall wood for fuel, cut three foot and four inches long, and ſeven inches and a half in compaſs; the aſſize of which is to be inquired of by juſtices.

BILLETING, in military affairs, is the quartering of ſoldiers in the houſes of a town or village. And, among fox-hunters, it ſignifies the ordure and dung of a fox.

BILLIARDS, an ingenious kind of game, played on a rectangular table, covered with green cloth, and placed exactly level, with little ivory balls, which are driven by crooked ſticks, made on purpoſe, into hazards or holes, on the edge and corners of the table, according to certain rules of the game

BILLINGHAM, a market-town of Northumberland, about twenty-five miles north-weſt of Newcaſtle, in W. long. 1° 40′, and N. lat. 55° 20′.

BILLITON, an iſland in the E. Indian ocean, lying ſouth-weſt of Bornea, in 1° 12′ S. lat.

BILLON, in the hiſtory of coins, a compoſition of precious and baſe metals, where the latter predominate. Wherefore gold under twelve carats fine, is called billon of gold; and ſilver under ſix penny-weight, billon of ſilver. So little attention was paid formerly to the purity of gold and ſilver, that the term billon of gold was applied only to that which was under twenty-one carats; and billon of ſilver to that which was lower than ten penny-weight.

Billon, in geography, a town of the Lower Auvergne, in the Lyonois in France, about ten miles ſouth-eaſt of Clermont; E. long. 3° 25′, and N. lat. 45° 40′

BILSDON, a market-town of Leiceſterſhire, about ſeven miles ſouth-eaſt of Leiceſter; W. long. 50′, and N. lat. 52° 40′.

BILSEN, a town of Germany, about ſix miles weſt of Maeſtricht; E. long. 5° 30′, and N. lat. 51°.

BIMEDIAL, in mathematics. If two medial lines, as AB and BC, commenſurable only in power, containing a rational rectangle, are compounded, the whole line AC will be irrational, and is called a firſt bimedial line.

A ——————————B—————————— C

See Euclid. lib. X. prop. 38.

BIMINI, one of the Lucaya-iſlands, in N. America, to the ſouth of the Bahama-iſlands.

BIMLIPATAN, a port-town of Golconda in India, where the Dutch have a factory. It is ſituated on the weſt ſide of the bay of Bengal, in 83° E. long. and 18° N. lat.

BINARY *arithmetick*, that wherein unity, or 1 and 0 are only uſed.

This was the invention of M. Leibnitz, who ſhe[illegible] it to be very expeditious in diſcovering the prop[illegible] of numbers, and in conſtructing tables: an[illegible] Dangecourt, in the hiſtory of the royal acade[illegible] ſciences, gives a ſpecimen of it concerning arith[illegible]cal progreſſionals; where he ſhews, that becauſe, in binary arithmetick, only two characters are uſed, therefore the laws of progreſſion may be more eaſily diſcovered by it than by common arithmetic.

All the characters uſed in binary arithmetick are 0 and 1, and the cipher multiplies every thing by 2, as in the common arithmetic by 10. Thus 1 is one; 10, two; 11, three; 100, four; 101, five; 110, ſix; 111, ſeven; 1000, eight; 1001, nine; 1010, ten; which is built on the ſame principles with common arithmetick.

The author, however, does not recommend this method for common uſe, becauſe of the great number of figures required to expreſs a number; and adds, that if the common progreſſion were from 12 to 12, or from 16 to 16, it would be ſtill more expeditious.

Binary *meaſure*, in muſic, is a meaſure which is beaten equally, or where the time of riſing is equal to that of falling. This is uſually called common time. See Music.

Binary *number*, that compoſed of two units.

BINDBROKE, a market-town of Lincolnſhire, about twenty-five miles north-eaſt of Lincoln; E. long. 6′, and N. lat. 53° 32′.

BINCH, a little fortified town of Hainault, ten miles eaſt of Mons; E. long. 4° 20′, and N. lat. 50° 30′.

BIND, a country-word for a ſtalk of hops.

Bind *of eels*, a quantity, conſiſting of 250, or 10 ſtrikes, each containing 25 eels.

BINDING, in a general ſenſe, the faſtening of two or more together by a vinculum or bond.

Book-Binding. See Book-binding.

Binding, among fencers, denotes the ſecuring the adverſary's ſword, which is effected by a preſſure and ſpring from the wriſt.

Binding,

Bishop's-castle, a borough-town in Shropſhire, ſituated on the river Ony, about 15 miles ſouth-weſt of Shrewſbury, in 3° W. long. and 52° 30′ N. lat.

Bishop and his clerks, ſome little iſlands and rocks on the coaſt of Pembrokeſhire, not far from St David's, very fatal to mariners.

Bishop's-stortford, a market-town in Hertfordſhire, 30 miles north of London, and only 10 miles north-eaſt of Hertford; in 20′ E. long. 51° 30′ N. lat.

BISHOPING, a term among horſe-courſers, to denote the ſophiſtications uſed to make an old horſe appear young, a bad one good, *&c.*

BISHOPRIC, the diſtrict over which a biſhop's juriſdiction extends, otherwiſe called a dioceſe.

In England there are twenty-four biſhoprics, and two archbiſhoprics; in Scotland, none at all; in Ireland, eighteen biſhoprics, and four archbiſhoprics.

BISIGNANO, a city of Hither Calabria, in the kingdom of Naples; in 16° 45′ E. long. and 39° 50′ N. lat.

BISKET, a kind of bread prepared by the confectioners, of fine flour, eggs, and ſugar, and roſe or orange-water; or of flour, eggs, and ſugar, with aniſeeds and citron-peel, baked again and again in the oven, in tin or paper moulds. There are divers ſorts of biſkets, as ſeed-biſket, fruit-biſket, long biſket, round biſket, naples-biſket, ſpunge-biſket, *&c.*

Sea-Bisket is a ſort of bread much dried by paſſing the oven twice, to make it keep for ſea-ſervice. For long voyages they bake it four times, and prepare it ſix months before the embarkation. It will hold good a whole year.

BISMILLA, a ſolemn form uſed by the Mahometans at the beginning of all their books and other writings, ſignifying, *In the name of the moſt merciful God.*

BISMUTH, a ponderous brittle ſemi-metal, reſembling zinc and the regulus of antimony, but differing greatly from them in quality. It diſſolves with vehemence in the nitrous acid, which only corrodes the regulus of antimony; and is ſcarce ſoluble in the marine acid, which acts ſtrongly on zinc. A calx and flowers of biſmuth have been recommended as ſimilar in virtue to certain antimonial preparations; but are at preſent of no other uſe than as a pigment or coſmetic.

Biſmuth is ſometimes found native, in ſmall compact maſſes, of a pale lead-colour on the outſide, but a ſilvery white within. It attenuates the parts of all other metals, and thereby promotes their fuſion. When diſſolved in ſtrong acids, it yields the famous coſmetic magiſtery, and is a very valuable ingredient in the mixed metals uſed in caſting types, and for bell-metal.

Biſmuth is very common in Germany, and not unfrequently found in the tin-mines of Cornwall, though little known, or at leaſt regarded, there.

BISNAGER, the capital of a province of the ſame name in the higher peninſula of India; in 78° E. long. and 14° N. lat.

BISNOW, or Bischnou, a ſect of the Banians in the Eaſt Indies; they call their god Ram-ram, and give him a wife: They adorn his image with golden chains, necklaces of pearls, and all ſorts of precious ſtones. They ſing hymns in honour of their god, mixing their devotion with dances and the ſound of drums, flagelets, brazen baſons, and other inſtruments. This ſect lives wholly upon herbs and pulſe, butter and milk.

BISOCHI, or Bizochi. See Bizochi.

BISOMUM, or Disomum, in Roman antiquity, a ſepulchre, or vault, containing two dead bodies. On the tombs of the primitive Chriſtians were wont to be inſcribed the words *biſomi*, or *triſomi*, or *quadriſomi*, *&c.* that by theſe means they might the eaſier calculate the number of their dead.

BISON, in zoology, the trivial name of a ſpecies of bos. See Bos.

BISQUET, or Bisket. See Bisket.

BISSACRAMENTALES, a denomination given to Proteſtants, on account of their allowing of only two ſacraments, *viz.* baptiſm and the euchariſt.

BISSECTION, in geometry, the diviſion of a line, angle, *&c.* into two equal parts.

BISSELÆUM, among ancient naturaliſts, denotes the oil of pitch, more properly called *piſſelæum*. See Pisselæum.

BISSEXTILE, in chronology, a year conſiſting of 366 days, being the ſame with our leap-year. See Astronomy, *Of the diviſion of time.*

BISTER. See Bistre.

BISTI, in commerce, a ſmall coin of Perſia: Some ſay that it is among the current ſilver coins of Perſia, and worth only a little above three farthings of our money; others ſpeak of it again as a money of account.

BISTORTA, in botany, the trivial name of a ſpecies of polygonum. See Polygonum.

BISTOURY, in ſurgery, an inſtrument for making inciſions, of which there are different kinds, ſome being of the form of a lancet, others ſtrait and fixed in the handle like a knife, and others crooked with the ſharp edge on the inſide. See Surgery.

BISTRE, or Bister, among painters, denotes gloſſy ſoot, pulveriſed and made into a kind of cakes, with gum-water. It is uſed to waſh their deſigns. See Washing.

BIT, or Bitt, an eſſential part of a bridle. Its kinds are various. 1. The muſrol, ſnaffle, or watering-bit. 2. The canon-mouth, jointed in the middle. 3. The canon with a faſt mouth, all of a piece, only kneed in the middle, to form a liberty or ſpace for the tongue; fit for horſes too ſenſible, or tickliſh, and liable to be continually bearing on the hand. 4. The canon-mouth, with the liberty in form of a pigeon's neck; proper where a horſe has too large a tongue. 5. The canon with a port mouth, and an upſet or mounting liberty; uſed where a horſe has a good mouth, but large tongue. 6. The ſcatch-mouth, with an upſet; ruder but more ſecure than a canon-mouth. 7. The canon-mouth with a liberty; proper for a horſe with a large tongue, and round bars. 8. The maſticadour, or ſlavering-bit, *&c.* The ſeveral parts of a ſnaffle, or curb-bit, are the mouth piece, the cheeks and eyes, guard of the cheek, head of the cheeks, the port, the welts, the campanel or curb and hook, the boſſes, the bolſters and rabbets, the water-chains, the ſide-bolts, bolts,

bolts, and rings, kirbles of the bit or curb, trench, toprol, flap, and jeive. The importation of bits for bridles is now prohibited.

Bit alſo denotes the iron part of a piercer, augre, and the like inſtruments.

Bit *of a key*, the part which contains the wards. See Wards.

Bit, or Bitts, in ſhip-building, the name of two great timbers, uſually placed abaft the manger, in the ſhip's loof, through which the croſs piece goes: The uſe of it is to belay the cable thereto, while the ſhip is at anchor.

BITCH, the female of the dog kind. See Canis.

BITONTO, a city of the province of Barri, in the kingdom of Naples, ſituated about eight miles ſouth-weſt of Barri, in 17° 40′ E long. and 41° 20′ N. lat.

BITTACLE, on ſhip-board, a ſquare box ſtanding before him that ſteers the ſhip, with the compaſs placed therein, to keep and direct the ſhip in her courſe.

BITTER, an epithet given to all bodies of an oppoſite taſte to ſweetneſs. For the medical virtues of bitters, ſee Materia Medica.

Bitter, a ſea-term, ſignifying any turn of the cable about the bits, ſo as that the cable may be let out by little and little. And when a ſhip is ſtopped by a cable, ſhe is ſaid *to be brought up by a bitter*. Alſo that end of the cable which is wound about the bits is called *the bitter end of the cable*.

Bitter-apple, in botany. See Colocynthis.

Bitter-salt. See Epsom-salt.

Bitter-sweet, in botany. See Solanum.

Bitter-waters. See Water.

Bitter-wine. See Wine.

BITTERN, in ornithology. See Ardea.

Bittern, in the ſalt-works, the brine remaining after the ſalt is concreted: This they ladle off, that the ſalt may be taken out of the pan, and afterwards put in again; when, being farther boiled, it yields more ſalt. See Salt.

BITUMEN, in natural hiſtory. See Asphaltum.

BIVALVES, a term ſometimes uſed for ſuch ſhells as conſiſt of two pieces. It is alſo an appellation given to ſuch pods, or capſules, as conſiſt of two valves incloſing the ſeeds.

BIVENTER, in anatomy, called alſo digaſtric, or two-bellied, a muſcle of the lower jaw. See p. 222. col. 1.

BIUMBRES, in geography, the ſame with the *amphiſcii*. See Amphiscii.

BIXA, in botany, a genus of the polyandria mongynia claſs. The corolla conſiſts of 10 petals; the calix has five teeth; and the capſule is rough, and double-valved. There is but one ſpecies, *viz.* the orellana, a native of America.

BIZARRO, in the Italian muſic, denotes a fanciful kind of compoſition, ſometimes faſt, ſlow, ſoft, ſtrong, *&c.* according to the fancy of the compoſer.

BIZOCHI, or Bisochi, in church-hiſtory, certain heretical monks, ſaid to have aſſumed the religious habit contrary to the canons, rejected the ſacraments, and maintained other errors.

BIZU, a town of Barbary, in Africa, in the kingdom of Morocco.

BLACK, a well known colour, ſuppoſed to be owing to the abſence of light; all the rays thereof being abſorbed by the black bodies. See Optics

Black, among dyers, one of the five ſimple and mother colours uſed in dying. It is made differently, according to the ſeveral qualities of the ſtuffs that are to be dyed. For ſtuffs of a high price, as woolen cloth an ell and a half or an ell and a quarter wide, broad and narrow rattens, fine woollen druggets, *&c.* they muſt uſe a black made of the beſt woad and indigo, inclining to a bluiſh brown. The goodneſs of the compoſition conſiſts in there being not above ſix pounds of indigo ready prepared to each ball of woad, when the latter, being in the tub, begins to caſt its blue flower; and in not being heated for uſe above twice; after which it muſt be boiled with alum, tartar, or aſhes of lees of wine, then maddered with common madder, and laſtly the black muſt be given with gall-nuts of Aleppo, copperas, and ſumach. As for more indifferent ſtuffs, ſuch as ſmall rattens, and ſhalloons, as they cannot pay for the expence of maddering it is ſufficient that they be well boiled with woad, and afterwards blacked with gall and copperas. There is likewiſe jeſuits black, which is made with the ſame ingredients as the good black, but without having firſt dyed the ſtuff blue.

German Black, called by ſome Frankfort black, is made with the lees of wine, burnt, waſhed afterwards in water, then ground in mills made for that purpoſe, with ivory, bones, or peach-ſtones, alſo burnt. It comes from Frankfort, Mentz, and Straſbourg, either in lumps or powder, and muſt be choſen moiſt, without having been wetted, of a fine ſhining black, ſoft, friable, light, and with as few ſhining grains as poſſible.

Ivory Black, otherwiſe called velvet black, is burnt ivory, which becoming quite black, and being reduced to thin plates, is ground in water, and made into troches, to be uſed by painters, and by jewellers, who ſet precious ſtones, to blacken the ground of the collets, and give the diamonds a teint or foil. In order to be good, it ought to be tender, friable, and thoroughly ground.

Bone-Black is made with the bones of oxen, cows, *&c.* and is uſed in painting; but is not ſo much eſteemed as ivory black.

Hart's-Black, that which remains in the retort after the ſpirits, volatile ſalt, and oil, have been extracted from hart's-horn. It anſwers the purpoſes of painters almoſt as well as ivory-black.

Spaniſh Black is nothing but burnt cork: It is uſed in ſeveral works. It ſhould be light, and have as few grains of ſand mixed with it as poſſible.

Lamp-Black, or *Lam*-Black, the ſooty ſmoke of roſin. There is ſome in powder and ſome in lumps, and is moſtly brought from Sweden and Norway, and pays duty 1 l. 10s. $4\frac{80}{100}$d. the hundred weight. It is uſed on various occaſions, particularly for making the printer's ink, for which purpoſe it is mixed with oil of walnuts, or linſeed, and turpentine, all boiled together.

Earth-Black, a ſort of coals found in the ground, with which the painters and limners uſe to paint in freſco, after it has been well ground.

There

There is alſo a black made with gall nuts, copperas, or vitriol, ſuch as common ink. And a black made with ſilver and lead, which ſerves to fill up the cavities of ingraved things.

Currier's BLACK, a black made with gall-nuts, ſour beer, and old iron, termed the firſt black The ſecond black, which gives the gloſs to the leather, is compoſed of gall-nuts, copperas, and gum-arabic.

BLACK-*bank*, in geography, a town of Ireland, about ſeven miles ſouth of Armagh, in 6° 50′ W. long. and 54° 12′ N. lat.

BLACK-*berry*, in botany. See RUBUS.

BLACK-*book of the exchequer*. See EXCHEQUER.

BLACK-*bourn*, a market-town of Lancaſhire, about nine miles eaſt of Preſton, in 2° 20′ W. long. and 53° 40′ N. lat.

BLACK-*cap*, in ornithology, the Engliſh name of the muſcicapa utricapilla. See MUSCICAPA.

BLACK-*eagle*. See FALCO.

BLACK-*foreſt*, a part of Swabia, divided from Switzerland by the river Rhine.

BLACK-*game*. See TETRAO.

BLACK-*mail*, a link of mail, or ſmall pieces of metal or money. In the counties of Northumberland, Cumberland, Weſtmoreland, and ſeveral parts of Scotland, it was formerly taken for a certain rent of money, corn, cattle, or other conſideration, paid by poor people near the borders, to perſons of note and power, allied with ſome moſs-troopers, or known robbers, in order to protect them from pillage.

BLACK-*order*. See ORDER.

BLACK-*rod*. See ROD.

BLACK-*ſea*, the ſame with the Euxine ſea, lying north of Natolia, between 29° and 44° E. long. and 42° and 46° N. lat.

BLACK-*tin*. See TIN.

BLACK-*water*, the name of two rivers in Ireland; one of which runs through the counties of Cork and Waterford, and falls in Youghal bay; and the other after watering the county of Armagh, falls into Lough Neagh.

BLACKS, in phyſiology. See NEGROES.

BLADDER, in anatomy. See p. 269. col. 2.

Air-BLADDER, in phyſiology. See AIR.

Oil-BLADDERS. See OIL.

BLÆRIA, in botany, a genus of the tetrandria monogynia claſs. The calix is divided into four ſegments, as alſo the corolla; the ſtamina are inſerted into the receptacle; and the capſule has four cells, containing many ſeeds. There is but one ſpecies, *viz.* the cricoides, a native of the cape of Good Hope.

BLAFART, in commerce, a ſmall coin, current at Cologn, worth ſomething more than a farthing of our money.

BLAIN, among farriers, a diſtemper incident to beaſts, being a certain bladder growing on the root of the tongue, againſt the wind-pipe, which ſwells to ſuch a pitch as to ſtop the breath. It comes by great chaffing and heating of the ſtomach. and is perceived by the beaſt's gaping and holding out his tongue, and foaming at the mouth. To cure it, caſt the beaſt, take forth his tongue, and then, ſlitting the bladder, waſh it gently with vinegar and a little ſalt.

BLAIR *of Athol*, a ſmall town of Athol in Scotland, ſituated about twenty-eight miles north of Perth.

BLAIRIA, in botany. See VERBENA.

BLAKEA, in botany, a genus of the dodecandria monogynia claſs. The calix has five leaves; the petals are ſix; the antheræ are connected; and the capſule has ſix cells. There is only one ſpecies, *viz.* the trinervia, a native of Jamaica.

BLAMONT, a town of Lorrain, about twenty-eight miles ſouth-eaſt of Nancy, in E. long. 6° 45′ and N. lat. 48° 38′.

BLANC. See BLANK.

BLANCH-*holding*, in Scots law, a tenure by which the vaſſal is only bound to pay an eluſory yearly duty to his ſuperior merely as an acknowledgment of his right. See SCOTS LAW, tit. *The ſeveral kinds of holdings*.

Carte-BLANCHE. See CARTE.

BLANCHING, in a general ſenſe, denotes the art of bleaching or whitening.

BLANCHING of copper is done various ways, ſo as to make it reſemble ſilver. If it be done for ſale, it is felony by 8 and 9 William III. chap. xxvi.

BLANCHING, in coinage, the operation performed on the planchets or pieces of ſilver, to give them the requiſite luſtre and brightneſs. They alſo blanch pieces of plate, when they would have them continue white, or have only ſome parts of them burniſhed.

Blanching, as it is now practiſed, is peformed by heating the pieces on a kind of peel with a wood fire, in the manner of a reverberatory; ſo that the flame paſſes over the peel. The pieces being ſufficiently heated and cooled again, are put ſucceſſively to boil in two pans, which are of copper: In theſe they put water, common ſalt, and tartar of Montpelier. When they have been well drained of this water in a copper ſieve, they throw ſand and freſh water over them; and when dry, they are well rubbed with towels.

BLANCHING, among gardeners, an operation whereby certain ſallets, roots, *&c.* are rendered whiter than they would otherwiſe be.

It is this: After pruning off the tops and roots of the plants to be blanched, they plant them in trenches about ten inches wide, and as many deep, more or leſs. as is judged neceſſary; as they grow up, care is taken to cover them with earth, within four or five inches of their tops: This is repeated from time to time, for five or ſix weeks, in which time they will be fit for uſe, and of a whitiſh colour where covered by the earth.

BLANCHING alſo denotes the operation of covering iron plates with a thin coat or cruſt of tin.

BLANCO, or *Cape*-BLANCO, a promontory of Peru, in S. America, W. long. 81°, and S. lat. 3° 45′.

BLANCO is alſo the name of one of the Antille-iſlands, on the coaſt of Terra Firma, in W. long. 64°, and N. lat. 12°.

Cape-BLANCO is alſo a promontory of Africa, in 18° W. long. and 20° N. lat.

BLANFORD, a market town of Dorſetſhire, ten miles north

north of Pool, in 2° 20′ W. long. and 50° 50′ N. lat.

BLANES, a port-town of Catalonia in Spain, E. long. 2° 40′, N. lat. 41° 30′.

BLANK, or BLANC, properly ſignifies white. See WHITE.

BLANK, in commerce, a void or unwritten place which merchants ſometimes leave in their day-books or journals.

BLANK-*bar*, in law, the ſame with common bar. See BAR.

BLANK-*verſe*, in the modern poetry, that compoſed of a certain number of ſyllables, without the aſſiſtance of rhime. See VERSE and RHIME.

Point-BLANK. See POINT-*blank*.

BLANKENBURG, a town of Dutch Flanders, eight miles north-eaſt of Oſtend, in 3° E. long. and 51° 20′ N. lat.

BLANKENBURG is alſo the name of a town in lower Saxony, about forty-five miles ſouth-eaſt of Wolfembuttle, in 11° 15′ E. long. and 51° 50′. N. lat.

BLANKET, a coverlet for a bed. A ſtuff commonly made of white wool, and wrought in a loom like cloth; with this difference, that they are croſſed like ſerges.

When they come from the loom, they are ſent to the fuller; and after they have been fulled and well cleaned, they are naped with a fuller's thiſtle.

There are blankets made with the hair of ſeveral animals; as that of goats, dogs, and others.

French blankets, called *Paris mantles*, pay duty 12s. 11 d. each, if coloured and the manufacture of France; otherwiſe only 5 s. $1\frac{60}{100}$d. If uncoloured, and the manufacture of France, they pay each 9 s. $8\frac{25}{100}$ d. otherwiſe only 3 s. $10\frac{20}{100}$ d. Blankets imported into France, pay a duty of importation according to their fineneſs; namely, thoſe of fine wool, ſix livres *per* piece; thoſe of coarſe and middling wool, three livres. None can be imported but by the way of Calais and St Vallery.

BLANOS, a maritime town of Spain in Catalonia, near the mouth of the river Tordera.

BLANQUILLE, in commerce, a ſmall ſilver coin current in the kingdom of Morocco, and all that part of the coaſt of Barbary; it is worth about three-half-pence of our money.

BLARE, in commerce, a ſmall copper coin of Bern, nearly of the ſame value with the ratz.

BLAREGNIES, a town of the Auſtrian Netherlands, about ſeven miles ſouth of Mons; E. long. 3° 55′, and N. lat. 50° 30′.

BLASIA, in botany, a genus of the cryptogamia algæ claſs. The calix of what is called the male is cylindrical, and full of grains; the calix of the female is naked, and incloſing a roundiſh ſeed ſunk in the leaves. There is but one ſpecies, *viz.* the puſilla, or dwarf blaſia, a native of Britain.

BLASPHEMY, an indignity or injury offered to the Almighty, by denying what is his due, and of right belonging to him; or by attributing to the creature that which is due only to the Creator.

BLAST, in a general ſenſe, denotes any violent exploſion of air, whether occaſioned by gun-powder, or by the action of a pair of bellows.

BLASTS, among miners, the ſame with damps. See DAMPS.

BLAST, or BLIGHT, in huſbandry. See BLIGHT.

BLASTING, a term uſed by miners for the tearing up rocks which lie in their way, by the force of gunpowder.

BLATTA, or COCKROCHE, a genus of inſects belonging to the order of hemiptera, or ſuch as have four ſemicruſtaceous incumbent wings. The head of the blatta is inflected towards the breaſt; the antennæ, or feelers, are hard like briſtles; the elytra and wings are plain, and reſemble parchment; the breaſt is ſmooth, roundiſh, and is terminated by an edge or margin; the feet are fitted for running; and there are two ſmall horns above the tail. This inſect reſembles the beetle; and there are 10 ſpecies; *viz.* 1. The gigantea is of a livid colour, and has ſquare browniſh marks on the breaſt. It is found in Aſia and America, and is about the ſize of a hen's egg. 2. The alba is red, and the margin of the breaſt is white. It is found in Egypt. 3. The ſurinamenſis is livid, and the breaſt edged with white. It is a native of Surinam. 4. The americana is of an iron colour, and the hind part of the breaſt is white. The wings and elytra are longer than its body. It is found in America and the ſouth of France. 5. The pivea is white, with yellow feelers. It is a native of America. 6. The africana is aſh-coloured, and has ſome hairs on its breaſt. It is found in Africa. 7. The orientalis is of a duſky aſh colour, has ſhort elytra, with an oblong furrow in them. This ſpecies is frequent in America. They get into cheſts, *&c.* and do much hurt to cloaths; they infeſt peoples beds in the night, bite like bugs, and leave a very unſavoury ſmell behind them. They avoid the light, and ſeldom appear but in the night time. The female reſembles a kind of caterpillar, as it has no wings: She lays an egg of about one half the bulk of her belly. They eat bread, raw or dreſſed meat, linen, books, ſilk-worms and their bags, *&c.* Sir Hans Sloane ſays, that the Indians mix their aſhes with ſugar, and apply them to ulcers in order to promote the ſuppuration. 8. The germanica, is livid, and yellowiſh, with two black parallel lines on the breaſt. It is found in Denmark. 9. The lapponica, is yellow, and the elytra are ſpotted with black. It is found in Lapland, and feeds upon cheeſe, ſiſhes, *&c.* 10. The oblongata, is of an oblong figure; the colour is livid and ſhining; and it has two black ſpots on the breaſt. The feelers are red and clavated; and the feet are very hairy. It is a native of America.

BLATTA *byzantia*, in pharmacy. See UNGUIS.

BLATTARIA, in botany. See VERBASCUM.

BLAVET, or PORT-LEWIS, a port-town of Brittany in France, ſituated at the mouth of the river Blavet; W. long. 3°, and N. lat. 47° 40′.

BLAWBUREN, a town of Swabia, in Germany, about eleven miles eaſt of Ulm; E. long. 9° 45′, and N. lat. 48° 24′.

BLAYE,

BLAYE, a fortrefs of Guienne, in France, fituated on the river Garonne, about twenty-one miles north of Bourdeaux; W. long. 45′, and N. lat. 45° 70′.

The intention of it is, to hinder any fhip from going to Bourdeaux without permiffion.

BLAZE, a white fpot in a horfe's face.

Blaze. See Blare.

BLAZONING, or Blazonry, in heraldry, the decyphering the arms of noble families.

The word originally fignified the blowing or winding of a horn, and was introduced into heraldry as a term denoting the defcription of things borne in arms, with their proper fignifications and intendments, from an ancient cuftom the heralds, who were judges, had of winding an horn at jufts and tournaments, when they explained and recorded the atchievements of knights.

BLEA, in the anatomy of plants, the inner rind or bark. See Agriculture, Part I.

B L E A C H I N G.

BLEACHING is the art of whitening linen cloth, thread, *&c.*; which is conducted in the following manner by the bleachers of this country.

After the cloth has been forted into parcels of an equal finenefs, as near as can be judged, they are latched, linked, and then fteeped. Steeping is the firft operation which the cloth undergoes, and is performed in this manner. The linens are folded up, each piece diftinct, and laid in a large wooden veffel; into which is thrown, blood-warm, a fufficient quantity of water, or equal parts of water and lye, which has been ufed to white cloth only, or water with rye-meal or bran mixed with it, till the whole is thoroughly wet, and the liquor rifes over all. Then a cover of wood is laid over the cloth, and that cover is fecured with a poft betwixt the boards and the joifting, to prevent the cloth from rifing during the fermentation which enfues. About fix hours after the cloth has been fteeped in warm water, and about twelve in cold, bubbles of air arife, a pellicle is formed on the furface of the liquor, and the cloth fwells when it is not preffed down. This inteftine motion continues from thirty-fix to forty-eight hours, according to the warmth of the weather; about which time the pellicle or fcum begins to fall to the bottom. Before this precipitation happens, the cloth muft be taken out; and the proper time for taking it out, is when no more air-bubbles arife. This is allowed to be the jufteft guide by the moft experienced bleachers.

The cloth is then taken out, well rinfed, difpofed regularly by the felvage, and wafhed in the put-mill to carry off the loofe duft. After this it is fpread on the field to dry: When thoroughly dried, it is ready for bucking; which is the fecond operation.

Bucking, or the application of falts, is performed in this manner. The firft, or mother lye, is made in a copper, which we fhall fuppofe, for example, when full, holds 170 Scots gallons of water. The copper is filled three fourths full of water, which is brought to boil: juft when it begins, the following proportion of afhes is put into it, *viz.* 30 lb. of blue, and as much white pearl-afhes; 200 lb. of Marcoft afhes, (or, if they have not thefe, about 300 lb. of Cafhub); 300 lb. of Mufcovy, or blanch afhes; the three laft ought to be well pounded. This liquor is allowed to boil for a quarter of an hour, ftirring the afhes from the bottom very often; after which the fire is taken away. The liquor muft ftand till it has fettled, which takes at leaft fix hours, and then it is fit for ufe.

Out of their firft, or mother-lye, the fecond, or that ufed in bucking, is made in this manner. Into another copper, holding, for example, 40 Scots gallons, are put 38 gallons of water, 2 lb. foft foap, and 2 gallons of mother-lye; or, for cheapnefs, in place of the foap, when they have lye which has been ufed to white linen, called *white-linen lye*, they take 14 gallons of it, leaving out an equal quantity of water. This is called *bucking-lye*.

After the linens are taken up from the field dry, they are fet in the vat or cave, as their large veffel is called, in rows, endwife, that they may be equally wet by the lye; which, made blood-warm, is now thrown on them, and the cloth is afterwards fqueezed down by a man with wooden fhoes. Each row undergoes the fame operation, until the veffel is full, or all the cloth in it. At firft the lye is put on milk-warm, and, after ftanding a little time on the cloth, it is again let off by a cock into the bucking-copper, heated to a greater degree, and then put on the cloth again. This courfe is repeated for fix or feven hours, and the degree of heat gradually increafed, till it is, at the laft turn or two, thrown on boiling hot. The cloth remains after this for three or four hours in the lye; after which the lye is let off, thrown away, or ufed in the firft buckings, and the cloth goes on to another operation.

It is then carried out, generally early in the morning, fpread on the grafs, pinned, corded down, expofed to the fun and air, and watered for the firft fix hours, fo often, that it never is allowed to dry. Afterwards it is allowed to lie till dry fpots appear before it is watered. After feven at night it gets no more water, unlefs it be a very drying night. Next day, in the morning and forenoon, it is watered twice or thrice if the day be very dry; but if the weather be not drying, it gets no water: After which it is taken up dry if the green be clean; if not, it is rinfed, mill-wafhed, and laid out to dry again, to become fit for bucking.

This alternate courſe of bucking and watering, is performed for the moſt part, from ten to ſixteen times, or more, before the linen is fit for ſouring; gradually increaſing the ſtrength of the lye from the firſt to the middle bucking, and from that gradually decreaſing it till the ſouring begins. The lyes in the middle buckings are generally about a third ſtronger than the firſt and laſt.

Souring, or the application of acids to cloth, is the fourth operation. It is difficult to ſay when this operation ſhould commence, and depends moſtly on the ſkill and experience of the bleacher. When the cloth has an equal colour, and is moſtly freed from the ſprat, or outer bark of the lint, it is then thought fit for ſouring; which is performed in the following manner. Into a large vat or veſſel is powered ſuch a quantity of buttermilk, or ſour milk, as will ſufficiently wet the firſt row of cloth; which is tied up in looſe folds, and preſſed down by two or three men bare-footed. If the milk is thick, about an eighth of water is added to it; if thin, no water. Sours made with bran, or rye-meal and water, are often uſed inſtead of milk, and uſed milk-warm. Over the firſt row of cloth a quantity of milk and water is thrown, to be imbibed by the ſecond; and ſo it is continued till the linen to be ſoured is ſufficiently wet, and the liquor riſes over the whole. The cloth is then kept down by covers filled with holes, and ſecured with a poſt fixed to the joiſt, that it may not riſe. Some hours after the cloth has been in the ſour, air-bubbles ariſe, a white ſcum is found on the ſurface, and an inteſtine motion goes on in the liquor. In warm weather it appears ſooner, is ſtronger, and ends ſooner, than in cold weather. Juſt before this fermentation, which laſts five or ſix days, is finiſhed, at which time the ſcum falls down, the cloth ſhould be taken out, rinſed, mill-waſhed, and delivered to the women to be waſhed with ſoap and water.

Waſhing with ſoap and water, is the fifth operation; and is performed thus. Two women are placed oppoſite at each tub, which is made of very thick ſtaves, ſo that the edges, which ſlope inwards, are about four inches in thickneſs. A ſmall veſſel full of warm water is placed in each tub. The cloth is folded ſo that the ſelvage may be firſt rubbed with ſoap and warm water lengthways, till it is ſufficiently impregnated with it. In this manner all the parcel is rubbed with ſoap, and afterwards carried to be bucked.

The lye now uſed has no ſoap in it, except what it gets from the cloth; and is equal in ſtrength to the ſtrongeſt formerly uſed, or rather ſtronger, becauſe the cloth is now put in wet. From the former operation theſe lyes are gradually made ſtronger, till the cloth ſeems of an uniform white, nor any darkneſs or brown colour appears in its ground. After this the lye is more ſpeedily weakened than it was increaſed; ſo that the laſt which the cloth gets, is weaker than any it got before.

But the management of ſours is different; for they are uſed ſtrongeſt at firſt, and decreaſed ſo in ſtrength, that the laſt ſour, conſidering the cloth is then always taken up wet, may be reckoned to contain three fourths of water.

From the bucking it goes to the watering, as formerly, obſerving only to overlap the ſelvages, and tie it down with cords, that it may not tear; then it returns to the ſour, milling, waſhing, bucking, and watering again. Theſe operations ſucceed one another alternately till the cloth is whitened; at which time it is blued, ſtarched, and dried.

This is the method uſed in the whitening fine cloths. The following is the method uſed in the whitening of coarſe cloths.

Having ſorted the cloths, according to their quality, they are ſteeped in the ſame manner as the fine, rinſed, waſhed in the mill, and dried before boiling.

In this proceſs, boiling ſupplies the place of bucking, as it takes leſs time, and conſequently is thought cheapeſt. It is done in the following manner: 200 ℔. caſhub aſhes, 100 ℔. white Muſcovy, and 30 ℔. pearl-aſhes, boiled in 105 Scots gallons of water for a quarter of an hour, as in the proceſs for the fine cloth, makes the mother or firſt lye. The cloth-boiler is then to be filled two thirds full with water and mother-lye, about nine parts of the former to one of the latter; ſo that the lye uſed for boiling the coarſe cloth, is about a third weaker than that uſed in bucking the fine. Such a quantity of cloth is put into the foregoing quantity of lye, when cold, as can be well covered by it. The lye is brought gradually to the boil, and kept boiling for two hours; the cloth being fixed down all the time, that it does not riſe above the liquor. The cloth is then taken out, ſpread on the field, and watered, as mentioned before in the fine cloth.

As the ſalts of the lye are not exhauſted by this boiling, the ſame is continued to be uſed all that day, adding, at each boiling, ſo much of the mother-lye as will bring it to the ſame ſtrength as at firſt. The lye by boiling loſes in quantity ſomewhat betwixt a third and a fourth; and they reckon that in ſtrength it loſes about a half, becauſe they find in practice, that adding to it half its former ſtrength in freſh lye, has the ſame effect on cloth. Therefore ſome freſh lye, containing a fourth part of the water, and the half of the ſtrength of the firſt lye, makes the ſecond boiler equal in ſtrength to the firſt. To the third boiler they add ſomewhat more than the former proportion, and go on ſtill increaſing gradually to the fourth and fifth, which is as much as can be done in a day. The boiler is then cleaned, and next day they begin with freſh lye. Theſe additions of freſh lye ought always to be made by the maſter-bleacher, as it requires judgment to bring ſucceeding lyes to the ſame ſtrength as the firſt.

When the cloth comes to get the ſecond boiling, the lye ſhould be a little ſtronger, about a thirtieth part, and the deficiencies made up in the ſame proportion. For ſix or ſeven boilings, or fewer, if the cloth be thin, the lye is increaſed in this way, and then gradually diminiſhed till the cloth is fit for ſouring. The whiteſt cloth ought always to be boiled firſt, that it may not be hurt by what goes before.

In this proceſs, if the cloth cannot be got dry for boiling, buſineſs does not ſtop as in the fine; for after the coarſe

coarſe has dreeped on racks made for the purpoſe, it is boiled, making the lye ſtrong in proportion to the water in the cloth.

The common method of ſouring coarſe linen is, to mix ſome warm water and bran in the vat, then put a layer of cloth, then more bran, water, and cloth; and ſo on, till the cave is full. The whole is tramped with mens feet, and fixed as in the former proceſs. A thouſand yards of cloth, yard-broad, require betwixt four and ſix pecks of bran. The cloth generally lies about three nights and two days in the ſour. Others prepare their ſour twenty-four hours before, by mixing the bran with warm water in a ſeparate veſſel; and before pouring it on the cloth, they dilute it with a ſufficient quantity of water. After the cloth is taken from the ſour, it ought to be well waſhed and rinſed again. It is then given to men to be well ſoaped on a table, and afterwards rubbed betwixt the rubbing-boards. When it comes from them, it ſhould be well milled, and warm water poured on it all the time, if conveniency will allow of it. Two or three of theſe rubbings are ſufficient, and the cloth very ſeldom requires more.

The lye, after the ſouring begins, is decreaſed in ſtrength by degrees; and three boilings after that are commonly ſufficient to finiſh the cloth. Afterwards it is ſtarched, blued, dried, and bittled in a machine made for that purpoſe, which ſupplies the place of a calendar, and is preferred by many to it.

This method uſed in the bleaching of our coarſe cloths, is very like that practiſed in Ireland for both fine and coarſe. The only material difference is, that there the bleachers uſe no other aſhes but the kelp or caſhub. A lye is drawn from the former by cold water, which diſſolves the ſalts, and not the ſulphureous particles of the kelp aſhes. This lye is uſed till the cloth is half whitened, and then they lay aſide the kelp-lye for one made of caſhub aſhes.

In the preceding hiſtory of bleaching we may obſerve, that it naturally divides itſelf into ſeveral different branches or parts, all tending to give linen the degree of whiteneſs required. How they effectuate that comes next to be conſidered.

The general proceſs of bleaching divides itſelf into theſe different parts. 1. Steeping and milling. 2. Bucking and boiling. 3. Alternate watering and drying. 4. Souring. 5. Rubbing with ſoap and warm water, ſtarching, and bluing. We ſhall treat of theſe different parts in their order.

STEEPING.

Green linen, in the different changes which it has undergone before it arrives at that ſtate, contracts a great foulneſs. This is chiefly communicated to it by the dreſſing compoſed of tallow and ſowen, which is a kind of flummery made of bran, flour, or oat-meal ſeeds. The firſt thing to be done in the bleachfield is to take off all that filth which is foreign to the flax, would blunt the future action of the ſalts, and might, in unſkilful hands, be fixed in the cloth. This is the deſign of ſteeping.

To accompliſh this end, the cloth is laid to ſteep in blood-warm water. A ſmaller degree of heat would not diſſolve the dreſſing ſo ſoon; and the greater might coagulate and fix, in the body of the linen, thoſe particles which we deſign to carry off. In a few hours the dreſſing made uſe in weaving is diſſolved, mixed with the water; and, as it had acquired ſome degree of acidity, before application, it becomes a ſpecies of ferment. Each ferment promotes its own particular ſpecies of fermentation, or inteſtine motion; the putrid ferment ſets in motion the putrefactive fermentation; the vinous ferment gives riſe to the vinous fermentation; and the acid ferment to the acetous fermentation. That there is a real fermentation going on in ſteeping, one muſt be ſoon convinced, who attends to the air-bubbles which immediately begin to ariſe, to the ſcum which gathers on the ſurface, and to the inteſtine motion and ſwelling of the whole liquor. That it muſt be the acetous fermentation, appears from this, that the vegetable particles, already in part ſoured, muſt firſt undergo this proceſs.

The effect of all fermentations is to ſet the liquor in motion; to raiſe in it a degree of heat; and to emit air-bubbles, which, by carrying up ſome of the light oleaginous particles along with them, produce a ſcum. But as the dreſſing is in ſmall quantity in proportion to the water, theſe effects are gentle and ſlow. The acid ſalts are no ſooner ſeparated, by the acetous fermentation, from the abſorbent earth, which made them not perceptible to the tongue in their former ſtate, than they are united to the oily particles of the tallow, which likewiſe adhere ſuperficially, diſſolve them, and render them, in ſome degree, miſſible with water. In this ſtate they are ſoon waſhed off by the inteſtine motion of the liquor. The conſequence of this operation is, that the cloth comes out freed in a great meaſure from its ſuperficial dirt; and more pliant and ſoft than what it was.

Whenever this inteſtine motion is pretty much abated, and before the ſcum ſubſides, bleachers take out their cloth. The ſcum, when no more air-bubbles riſe to ſupport it, ſeparates, and falls down; and would again communicate to the cloth great part of the filth. But a longer ſtay would be attended with a much greater diſadvantage. The putrid follows cloſe upon the acetous fermentation: When the latter ends, the former begins. Were this to take place, in any conſiderable degree, it would render the cloth black and tender. Bleachers cannot be too careful in this article.

The firſt queſtion that ariſes to be determined on theſe principles is, What is the propereſt liquor for ſteeping cloth? Thoſe uſed by bleachers are plain water; white-linen lye and water, equal parts; and rye-meal or bran mixed with water. They always make uſe of lye when they have it.

After ſteeping, the cloth is carried to the putſtock-mill, to be freed of all its looſe foulneſs. There can be nothing contrived ſo effectual to anſwer the purpoſe as this mill. Its motion is eaſy, regular, and ſafe. While it preſſes gently, it turns the cloth; which is continually waſhed with a ſtream of water. Care muſt be taken that no water be detained in the folds of the linen, otherwiſe that part may be damaged.

BUCKING

BUCKING AND BOILING.

This is the moſt important operation of the whole proceſs, and deſerves a thorough examination. Its deſign is to looſen, and carry off, by the help of alkaline lixives or lyes, that particular ſubſtance in cloth, which is the cauſe of its brown colour.

All aſhes uſed in lye, the pearl excepted, ought to be well pounded, before they are put into the copper; for the Marcoſt and Caſhub are very hard, and with ſome difficulty yield their ſalts. As theſe two laſt contain a very conſiderable proportion of a real ſulphureous matter, which muſt in ſome degree tinge white cloth; and as this is diſſolved much more by boiling, than by the inferior degrees of heat, while the ſalts may be as well extracted by the latter. The water ſhould never be brought to boil, and ſhould be continued for ſome time longer under that degree of heat. The pearl-aſhes ſhould never be put in till near the end, as they are eaſily diſſolved in water.

If the ſalts were always of an equal ſtrength, the ſame quantities would make a lye equally ſtrong; but they are not. Salts of the ſame name differ very much from one another. The Muſcovy aſhes are turning weaker every day, as every bleacher muſt have obſerved, till at laſt they turn quite effete. A decoction from them when new, muſt differ very much from one when they have been long kept. Hence a neceſſity of ſome exact criterion to diſcover when lyes are of an equal ſtrength. The taſte cannot ſerve, as that is ſo variable, cannot be deſcribed to another, and is blunted by repeated trials. The proof-ball will ſerve the purpoſe of the bleachfield ſufficiently; and, by diſcovering the ſpecific gravity, will ſhow the quantity of alkaline ſalts diſſolved. But it cannot ſhow the dangerous qualities of theſe ſalts; for the leſs cauſtic and leſs heavy this liquor is, the more dangerous and corroſive it may be for the cloth.

The third lye, which they draw from theſe materials by an infuſion of cold water, in which the taſte of lime is diſcoverable, appears plainly to be more dangerous than the firſt. The ſecond lye, which they extract from the ſame aſhes, and which is reckoned about a third in ſtrength, when compared to the firſt, muſt be of the ſame nature; nor ſhould it be uſed without an addition of pearl-aſhes, which will correct it.

It is taken for a general rule, That the ſolution of any body in its menſtruum is equally diffuſed through the whole liquor. The bleachers depending on this, uſe equal quantities of the top and bottom of their lye, when once clear and ſettled; taking it for granted, that there is an equal quantity of ſalts in equal quantities of the lye. But if there is not, the miſtake may be of fatal conſequence, as the lye may be in ſome places ſtronger than what the cloth can with ſafety bear. That general law of ſolution muſt have taken its riſe from particular experiments, and not from reaſoning. Whether a ſufficient number of experiments have been tried to aſcertain this point, and to eſtabliſh an undoubted general rule, may be called in queſtion.

"But, ſays Dr Home, when I had diſcovered that lime makes part of the diſſolved ſubſtance, and reflected how long its groſſer parts will continue ſuſpended in water, there appeared ſtronger reaſons for ſuſpecting that this rule, though it may be pretty general, does not ake place here; at leaſt it is worth the purſuit of experiment.

"I weighed at the bleachfield a piece of glaſs in ſome cold lye, after it had been boiled, ſtood for two days, and about the fourth part of it had been uſed. The glaſs weighed 3 drachms $1\frac{1}{2}$ grains in the lye, and 3 drachms $7\frac{1}{2}$ grains in river-water. The ſame glaſs weighed in the ſame lye, when almoſt all uſed, 2 grains leſs than it had done before. This ſhows, that the laſt of the lye contained a third more of the diſſolved body; and, conſequently, was a third ſtronger than the firſt of the lye.

"As this might, perhaps, be owing to a continuation of the ſolution of the ſalts, I repeated the experiment in a different way.

"I took from the ſurface ſome of the lye, after the ſalts were diſſolved, and the liquor was become clear. At the ſame time I immerſed a bottle, fixed to a long ſtick, ſo near the bottom, as not to raiſe the aſhes there, and, by pulling out the cork by a ſtring, filled the bottle full of the lye near the bottom. The glaſs weighed in river-water 3 drachms $38\frac{1}{2}$ grains; in the lye taken from the ſurface 3 drachms $34\frac{1}{2}$ grains; and in the lye taken from the bottom 3 drachms $31\frac{1}{2}$ grains. This experiment ſhows, that the lye at the bottom was, in this caſe, $\frac{1}{4}$ ſtronger then the lye at the ſurface.

"At other times when I tried the ſame experiment, I found no difference in the ſpecific gravity; and therefore, I leave it as a queſtion yet doubtful, though deſerving to be aſcertained by thoſe who have an opportunity of doing it. As the lye ſtands continually on the aſhes, there can be no doubt but what is uſed laſt muſt be ſtronger than the firſt. I would, therefore, recommend, to general practice, the method uſed by Mr John Chriſtie, who draws off the lye, after it has ſettled, into a ſecond receptacle, and leaves the aſhes behind. By this means it never can turn ſtronger; and he has it in his power to mix the top and bottom, which cannot be done ſo long as it ſtands on the aſhes."

Having conſidered the lye, let us next inquire how it acts. On this inquiry depends almoſt the whole theory of bleaching, as its action on cloth is, at leaſt in this country, abſolutely neceſſary. It is found by experiment, that one effect they have on cloth, is the diminiſhing of its weight; and that their whitening power is, generally, in proportion to their weakening power. Hence ariſes a probability, that theſe lyes act by removing ſomewhat from the cloth, and that the loſs of this ſubſtance is the cauſe of whiteneſs. This appears yet plainer, when the bucking, which laſts from Saturday night to Monday morning is attended to.

There are various and different opinions with regard to the operation of theſe ſalts: That they act by altering the external texture of the cloth, or by ſeparating the mucilaginous parts from the reſt, or by extracting the oil which is laid up in the cells of the plant The laſt is the general opinion, or rather conjecture, for none of them deſerves any better name; but may we venture to affirm, that it is ſo without any better title to pre-eminence,

nence, than what the others have. Alkaline ſalts diſſolve oils, therefore theſe ſalts diſſolve the cellular oil of the cloth, is all the foundation which this theory has to reſt on; too ſlight, when unſupported by experiment, to be relied on.

Dr Home endeavours to ſettle this queſtion by the following experiments and obſervations.

" Wax, ſays he, is whitened by being expoſed to the influence of the ſun, air, and moiſture. A diſcovery of the changes made on it by bleaching, may throw a light upon the queſtion.

" Six drachms of wax were ſliced down, expoſed on a ſouth window, Sept. 10. and watered. That day being clear and warm, bleached the wax more than all the following. It ſeemed to me to whiten quicker when it had no water thrown on it, than when it had. Sept. 15. it was very white, and 1 drachm 3 grains lighter. $3\frac{1}{2}$ drachms of this bleached wax, and as much of unbleached, taken from the ſame piece, were made into two candles of the ſame length and thickneſs, having cotton wicks of the ſame kind. The bleached candle burned one hour thirty-three minutes; the unbleached three minutes longer. The former run down four times, the latter never. The former had an obſcure light and dull flame; the latter had a clear pleaſant one, of a blue colour at the bottom. The former when burning ſeemed to have its wick thicker, and its flame nearer the wax, than the latter. The former was brittle, the latter not. It plainly appears from theſe facts, that the unbleached wax was more inflammable than the bleached; and that the latter had loſt ſo much of an inflammable ſubſtance, as it had loſt in weight; and conſequently the ſubſtance loſt in bleaching of wax is the oily part.

" As I had not an opportunity of repeating the former experiment, I do not look on it as entirely concluſive; for it is poſſible that ſome of the duſt, flying about in the air, might have mixed with the bleached wax, and ſo have rendered it leſs inflammable. Nor do I think the analogical reaſoning from wax to linen without objections. Let us try then if we cannot procure the ſubſtance extracted from the cloth, ſhow it to the eye, and examine its different properties. The proper place to find it, is in a lye already uſed, and fully impregnated with theſe colouring particles.

" I got in the bleachfield ſome lye, which had been uſed all that day for boiling coarſe linen, which was tolerably white, and had been twice boiled before. There could be no dreſſing remaining in theſe webs. No ſoap had ever touched that parcel; nor do they mix ſoap with the lye uſed for coarſe cloth. Some of this impregnated lye was evaporated, and left a dark-coloured matter behind. This ſubſtance felt oily betwixt the fingers, but would not lather in water as ſoap does. It deflagrated with nitre in fuſion, and afforded a tincture to ſpirit of wine. By this experiment the ſalts ſeem to have an oily inflammable ſubſtance joined with them.

" Could we ſeparate this colouring ſubſtance from theſe ſalts, and exhibit it by itſelf ſo that it might become the object of experiment, the queſtion would be ſoon decided. Here chymiſtry lends us its aſſiſtance. Whatever has a ſtronger affinity or attraction to the ſalts with which it is joined, than this ſubſtance has, muſt ſet it at liberty, and make it viſible. Acids attract alkaline ſalt from all other bodies; and therefore will ſerve our purpoſe.

" Into a quantity of the impregnated lye mentioned in the former experiment, I poured in oil of vitriol. Some bubbles of air aroſe, an inteſtine motion was to be perceived, and the liquor changed its colour from a dark to a turbid white. It curdled like a ſolution of ſoap, and a ſcum ſoon gathered on the ſurface, about half an inch in thickneſs, the deepneſs of the liquor not being above ſix inches. What was below was now pretty clear. A great deal of the ſame matter lay in the bottom; and I obſerved, that the ſubſtance on the ſurface was precipitated, and ſhowed itſelf heavier than water, when the particles of air, attached to it in great plenty, were diſpelled by heat. This ſubſtance was in colour darker than the cloth which had been boiled in it.

" I procured a conſiderable quantity of it by ſkimming it off. When I tried to mix it with water, it always fell to the bottom. When dried by the air, it diminiſhed very much in its ſize, and turned as black as a coal. In this ſtate it deflagrated ſtrongly with nitre in fuſion; gave a ſtrong tincture to ſpirit of wine; and when put on a red-hot iron, burnt very ſlowly, as if it contained a heavy ponderous oil; and left ſome earth behind.

" From the inflammability of this ſubſtance, its rejecting of water, and diſſolving in ſpirit of wine, we diſcover its oleaginous nature; but from its great ſpecific gravity we ſee that it differs very much from the expreſſed or cellular oil of vegetables; and yet more from their mucilage. That it diſſolves in ſpirit of wine, is not a certain argument of its differing from expreſſed oils; becauſe theſe, when joined to alkaline ſalts, and recovered again by acids, become ſoluble in ſpirit of wine. The quantity of earthy powder left behind after burning, ſhows that it contains many of the ſolid particles of the flax. The ſubſtance extracted from cloth by alkaline lyes appears then to be a compoſition of a heavy oil, and the ſolid earthy particles of the flax.

" In what manner theſe ſalts act ſo as to diſſolve the oils, and detach the ſolid particles, is uncertain; but we ſee evidently how much cloth muſt be weakened by an improper uſe of them, as we find the ſolid particles themſelves are ſeparated."

It is neceſſary that cloth ſhould be dry before bucking, that the ſalts may enter into the body of the cloth along with the water; for they will not enter in ſuch quantity, if it be wet; and by acting too powerfully on the external threads, may endanger them.

The degree of heat is a very material circumſtance in this operation. As the action of the ſalts is always in proportion to the heat, it would appear more proper to begin with a boiling heat, by which a great deal of time and labour might be ſaved. The reaſon why this method is not followed, appears to be this. If any vegetable or vegetable ſubſtance is to be ſoftened, and to have its juices extracted, it is found more proper to give it gentle degrees of heat at firſt, and to advance gradually, than to plunge it all at once in boiling water. This laſt degree of heat is ſo ſtrong, that when applied at once to a vegetable, it hardens, inſtead of ſoftening its texture. Dried vegetables

vegetables are immediately put into boiling water by cooks, that thefe fubftances may preferve their green colour, which is only to be done by hindering them from turning too foft. Boiling water has the fame effect on animal fubftances; for if falt beef is put into it, the water is kept from getting at the falts, from the outfide of the beef being hardened.

But when we confider, how much of an oily fubftance there is in the cloth, efpecially at firft, which will for fome time keep off the water, and how the twifting of the threads, and clofenefs of the texture, hinders the water from penetrating, we fhall find, that if boiling water were put on it at once, the cloth might be liable, in feveral parts, to a dry heat, which would be much worfe than a wet one. That the lyes have not accefs to all parts of the cloth, at firft, appears plainly from this, that when it has lain, after the firft bucking, till all the lyes are wafhed out, it is as black, in fome parts, as when it was fteeped. This muft be owing to the difcharge of the colouring particles from thofe places to which the lye has accefs, and to their remaining where it has not. It would feem adviseable, then, in the firft bucking or two, when the cloth is foul, to ufe the lye confiderably below the boiling point; that by this foaking or maceration, the foulnefs may be entirely difcharged, and the cloth quite opened for the fpeedy reception of the boiling lye in the buckings which follow.

The lyes fhould likewife be weakeft in the firft buckings, becaufe then they act only on the more external parts; whereas, when the cloth is more opened, and the field of action is increafed, the active powers ought to be fo too. For this reafon they are at the ftrongeft after fome fourings.

The only thing that now remains to be confidered, is, the management of the coarfe cloth, where boiling is fubftituted in place of bucking. This fpecies of linen cannot afford the time and labour neceffary for the latter operation; and therefore they muft undergo a fhorter, and more active method. As the heat continues longer at the degree of boiling, the lyes ufed to the coarfe cloth muft be weaker than thofe ufed to the fine. There is not fo much danger from heat in the coarfe as in the fine cloth, becaufe the former is of a more open texture, and will allow the lye to penetrate more fpeedily. In the clofer kinds, however, the firft application of the falts fhould be made without a boiling heat.

ALTERNATE WATERING AND DRYING.

After the cloth has been bucked, it is carried out to the field, and frequently watered for the firft fix hours. For if during that time, when it is ftrongly impregnated with falts, it is allowed to dry, the falts approaching clofer together, and, affifted by a greater degree of heat, increafing always in proportion to the drinefs of the cloth, act with greater force, and deftroy its very texture. After this time, dry fpots are allowed to appear before it gets any water. In this ftate it profits moft, as the latter part of the evaporation comes from the more internal parts of the cloth, and will carry away moft from thofe parts. The bleaching of the wax, in a preceding experiment, helps to confirm this; for it feemed to whiten moft when the laft particles of water were going off.

This continual evaporation from the furface of the cloth fhows, that the defign of the operation is to carry off fomewhat remaining after the former procefs of bucking. This appears likewife from a fact known to all bleachers, that the upper fide of cloth, where the evaporation is ftrongeft, attains to a greater degree of whitenefs than the under fide. But it is placed beyond all doubt by experiment, which fhews, that cloth turns much lighter by being expofed to the influence of the fun, air, and winds, even though the falts have been wafhed out of it.

What, then, is this fubftance? As we have difcovered in the former fection, that the whitening, in the operation of bucking, depends on the extracting or loofening the heavy oil, and folid particles of the flax; it appears highly probable, that the effects of watering, and expofition to the fun, air, and winds, are produced by the evaporation of the fame fubftance, joined to the falts, with which compofite body the cloth is impregnated when expofed on the field. That thefe falts are in a great meafure carried off or deftroyed, appears from the cloth's being allowed to dry without any danger, after the evaporation has gone on for fome time. "If we can fhow, fays Dr Home, that oils and falts, when joined together, are capable of being exhaled, in this manner, by the heat of the atmofphere, we fhall reduce this queftion to a very great degree of certainty.

"Sept. 10. I expofed, in a fouth-weft window, half an oz. of Caftile foap, fliced down, and watered. Sept. 14. when well dried, it weighed but 3 dr. 6 gr. Sept. 22. it weighed 2 dr. 2 gr. Sept. 24. it weighed 1 dr. 50 gr. It then feemed a very little whiter; but was much more mucilaginous in its tafte, and had no degree of faltnefs, which it had before.

"It appears from this experiment, that foap is fo volatile, when watered, and expofed to air not very warm, that it lofes above the half its weight in fourteen days. The fame muft happen to the faponaceous fubftance, formed from the conjunction of the alkaline falts, heavy oil, and earthy particles of the flax. The whole defign, then, of this operation, which, by way of pre-eminence, gets the name of *bleaching*, is to carry off, by the evaporation of water, whatever has been loofened by the former procefs of bucking.

"Againft this doctrine there may be brought two objections, feemingly of great weight. It is a general opinion amongft bleachers, that linen whitens quicker in March and April, than in any other months: But as the evaporation cannot be fo great at that time, as when the fun has a greater heat; hence the whitening of cloth is not in proportion to the degree of evaporation; and therefore the former cannot be owing to the latter. This objection vanifhes, when we confider, that the cloth which comes firft into the bleachfield, in the fpring, is clofely attended, having no other to interfere with it for fome time; and, as it is the whiteft, gets, in the after buckings, the firft of the lye; while the fecond parcel is often bucked with what has been ufed to the firft. Were the fact true, on which the objection is founded, this would be

be a sufficient anſwer to the objection. But it appears not to be true, from an obſervation of Mr John Chriſtie, That cloth laid down in the beginning of June, and finiſhed in September, takes generally leſs work, and undergoes fewer operations, than what is laid down in March, and finiſhed in June.

" The other objection is, That cloth dries much faſter in windy weather than in calm ſunſhine; but it does not bleach ſo faſt. This would ſeem to ſhow, that the ſun has ſome particular influence independent on evaporation. In anſwer to this objection, let it be conſidered, that it is not the evaporation from the ſurface, but from the more internal parts that is of benefit to the cloth. Now, this latter evaporation muſt be much ſtronger in ſunſhine than in windy weather, on account of the heat of the ſun, which will make the cloth more open; while the coldneſs of windy weather muſt ſhut it up, ſo that the evaporation will all be from the ſurface. Clear ſunſhine, with a very little wind, is obſerved to be the beſt weather for bleaching; a convincing proof that this reaſoning is juſt.

" It would ſeem to follow as a corollary from this reaſoning, that the number of waterings ſhould in general be in proportion to the ſtrength of the lye; for the ſtronger the lye is, the more there is to be evaporated; and the greater the danger, in caſe the cloth ſhould be allowed to dry. But there is an exception to this general rule, ariſing from the conſideration of another circumſtance. It is obſerved, that cloth, when brown, dries ſooner than when it becomes whiter, ariſing from the cloſeneſs and oilineſs which it then has, not allowing the water a free paſſage. Perhaps that colour may retain a greater degree of heat, and in that way aſſiſt a very little. Cloth therefore, after the firſt buckings, muſt be more carefully watered than after the laſt.

" It follows likewiſe from this reaſoning, that the ſoil of the bleachfield ſhould be gravelly or ſandy, that the water may paſs quickly through it, and that the heat may be increaſed by the reflection of the ſoil: for the ſucceſs of this operation depends on the mutual action of heat and evaporation. It is likewiſe neceſſary that the water ſhould be light, ſoft, and free from mud or dirt, which, not being able to riſe along with the water, muſt remain behind. When there is much of this, it becomes neceſſary to rinſe the cloth in water, and then give it a milling, to take out the dirt; elſe it would be fixed in the cloth by the following bucking, as it is not ſoluble by the lye.

" This operation has more attributed to it by bleachers than it can juſtly claim. The cloth appears, even to the eye, to whiten under theſe alternate waterings and dryings; and theſe naturally get the honour of it, when it more properly belongs to the former operation. Here lies the fallacy. Alkaline ſalts give a very high colour to the decoctions, or infuſion of vegetables. This is probably owing to the ſolution of the oleaginous colouring particles of the plant; which particles, being opened and ſeparated by the ſalts, occupy a greater ſpace, and give a deep colour to the liquor. The cloth participates of the liquor and colour. Hence bleachers always judge of the goodneſs of the bucking by the deepneſs of its colour. The rule, in general, is good. I obſerve, that in thoſe buckings which continue from the Saturday night to the Monday morning, the cloth has always the deepeſt colour. When that cloth has been expoſed ſome hours to the influence of the air, theſe colouring particles, which are but looſely attached to it, are evaporated, and the linen appears of a brighter colour. This operation does no more than complete what the former had almoſt finiſhed. If its own merit were thoroughly known, there would be no occaſion to attribute that of another operation to it. Thread, and open cloths, ſuch as diaper, may be reduced to a great degree of whiteneſs, after one bucking, by it alone. No cloth, as would appear, can attain to a bright whiteneſs without it.

" Since the only advantage of watering is the removal of the ſalts, and what they have diſſolved, might we not effectuate this by ſome cheaper, and more certain method? For it occupies many hands; and muſt depend altogether on the uncertainty of the weather; ſo that, in the beginning of the ſeaſon, the bleacher is often obliged to repeat his buckings without bleaching. We might take out the alkaline ſalts by acids; but then the other ſubſtance would be left alone in the cloth, nor would any waſhing be able to remove it. Mill-waſhing appears a more probable method of taking out both ſalts and oils; and it would ſeem that this might, in a great meaſure, ſupply the place of watering; but upon trial it does not ſucceed. Two parcels of linen were managed equally in every other reſpect, except in this, that one was watered, and expoſed to the influence of the air, and the other was only mill-waſhed. This method was followed until they were fit for ſouring. The cloth which had been mill-waſhed, had a remarkable green colour, and did not recover the bright colour of the pieces managed in the common way, until it had been treated like them for a fortnight. The green colour was certainly owing to a precipitation of the ſulphureous particles, with which the lye is impregnated, upon the ſurface of the cloth; owing to the ſalts being waſhed off more ſpeedily than the ſulphur, to which they are united in the lye. The attachment betwixt theſe two bodies we know is very looſe, and the ſeparation eaſily made. Evaporation then alone is ſufficient to carry off theſe ſulphureous particles."

SOURING.

It is well known to all chymiſts, that alkaline ſalts are convertible, by different methods, into abſorbent earths. Frequent ſolution in water, and evaporation of it again, is one of theſe. This tranſmutation then of theſe ſalts, which are not volatiliſed or waſhed away, muſt be continually going on in the cloth under theſe alternate waterings and dryings of the former proceſs; not much indeed after the firſt two or three buckings; becauſe the ſalts, not having entered deep into the cloth, are eaſily waſhed off, or evaporated. But when they penetrate into the very compoſition of the laſt and minuteſt fibres, of which the firſt veſſels are made, they find greater difficulty of eſcaping again, and muſt be more ſubject to this tranſmutation. But if we conſider the bleaching

bleaching ashes as a composition of lime and alkaline salts, we must discover a fresh fund for the deposition of this absorbent earth. The common caustic, a composition of this very kind, soon converts itself, if exposed to the open air, into a harmless earthy powder.

Frequent buckings and bleachings load the cloth with this substance. It becomes then necessary to take it out. No washing can do that, because earth is not soluble in water. Nothing but acids can remove it. These are attracted by the absorbent earth, join themselves to it, and compose a kind of neutral imperfect salt, which is soluble in water; and therefore easily washed out of the cloth. The acid liquors commonly used are butter-milk, which is reckoned the best, sour milk, infusions of bran, rye-meal, *&c.* kept for some days till they sour. Sour whey is thought to give the cloth a yellow colour.

The linen ought to be dried before it is put in the sour, that the acid particles may penetrate, along with the watery, through the whole. A few hours after it has been there, air-bubles arise, the liquor swells, and a thick scum is formed; manifest signs of a fermentation. The following experiment, says Dr Home, shews the degree of heat which attends it.

" May 25. I put a thermometer of Fahrenheit's into some butter-milk, of which the bleachers were composing their sours, and which stood in a vat adjoining to another, where the milk was the same, and the souring process had been going on for two days. After the thermometer had been twenty minutes in the butter-milk, the mercury stood at 64 degrees. In the souring vat it rose to 68 degrees. An increase of 4 degrees shows a pretty brisk intestine motion

" To what are all these effects owing? To the acetous fermentation going on in those vegetable liquors, whose acids, extricating themselves, produce heat, intestine motion, and air-bubbles. As the change is slow, the process takes five or six days before it is finished. During this time the acid particles are continually uniting themselves to the absorbent earth in the cloth. That this fermentation goes on in the liquor alone, appears from this consideration, that the same effects, *viz.* air-bubbles, and scum, are to be seen in the butter-milk alone. The only effect then it has is, by the small degree of heat, and intestine motion, which attend it, to assist the junction of the acid and absorbent particles. We shall presently see, that this process may be carried on, to as great advantage, without any fermentation; and therefore it appears not absolutely necessary.

" When these absorbent particles are fully saturated, the remaining acids may unite with, and have some small effect in extracting the colouring particles. This appears from the two following experiments.

" Sept. 20. A piece of cloth which had been steeped, weighing $41\frac{1}{2}$ gr. was put into a half-pound of butter-milk, whigged, and well soured, by a mixture of water, and by boiling. Sept. 24. When taken out, and washed in water, it appeared a very little whiter. The mineral acids, as will appear afterwards, whiten cloth, even though they are very much diluted.

" Just before the acetous fermentation is finished, the cloth should be taken out; otherwise the scum will fall down, and lodge in the cloth, and the putrefaction which then begins will weaken it. This appears from the following experiment.

" Sep. 16. A piece of cloth, weighing 42. gr. was laid in butter-milk unwhigged. Novem. 15. The milk had a putrified smell. The cloth was a little whiter, but very tender; and weighed, when well washed in warm water and dried, 40 gr."

All the sours made of bran, rye-meal, *&c.* ought to be prepared before use; for by this means so much time will be saved. Besides, when the water is poured upon the cloth, and bran, as is done in the management of coarse cloth, the linen is not in a better situation than if it had been taken up wet from the field; and by this means the acid particles cannot penetrate so deep. Again, this method of mixing the bran with the cloth, may be attended with yet worse consequences. All vegetable substances, when much pressed, fall into the putrescent, and not the acetous fermentation. This often happens to the bran pressed betwixt the different layers on the linen, which must weaken the cloth. Hence, all sours should be prepared before the cloth is steeped in them; and none of the bran or meal should be mixed with the cloth.

The sours are used strongest at first, and gradually weakened till the cloth has attained to its whiteness. In the first sourings, there is more of the earthy matter in the cloth, from the many buckings it has undergone, than what there can be afterwards. As the quantity of this matter decreases, so should the strength of the sour. There is not, however, the least danger, at any time, from too strong a sour.

What is most wanted in this operation is a more expeditious and cheaper method of obtaining the same end. As it takes five or six days, it retards the whitening of the cloth considerably; and as bleachers are obliged to send for milk to a great distance, it becomes very dear. This last consideration makes them keep it so long, that, when used, it can have no good effect; perhaps it may have a bad one.

There is one consideration that may lead us to shorten the time. It is observed, that the souring process is sooner finished in warm than in cold weather. Heat quickens the fermentation, by aiding the intestine motion. The vats therefore should not be buried in the ground, as they always are, which must keep them cold; there should rather be pipes along the walls of the room, to give it that degree of heat, which, on trial, may be found to answer best. There are few days in summer so hot as is necessary; and the beginning and end of the season is by much too cold. That this is no ideal scheme, the following fact is a sufficient proof? There are two vats in Salton bleachfield, adjoining to a partition-wall, at the back of which there is a kitchen fire. In these vats the souring process is finished in three days, whereas it lasts five or six days in the others placed round the same room.

This improvement, though it shortens the time of souring a very little, yet is no remedy against the scarcity and dearness of milk sours. Such a liquor as would serve our purpose, must be found either among the vegetable

table acids, which have no further fermentation to undergo, or among the mineral acids. The former are a large clafs, and contain within themfelves many different fpecies; fuch as the acid juice of feveral plants, vinegars made of fermented liquors, and acid falts, called *tartars*. But there is one objection againft thefe vegetable acids: They all contain, along with the acid, a great quantity of oily particles, which would not fail to difcolour the cloth. Befides, the demand of the bleachfields would raife their price too high.

The mineral acids have neither of thefe objections. They are exceedingly cheap, and contain no oil. "I will freely own, fays Dr Home, that at firft I had no great opinion of fuccefs from the mineral, from two reafons; their want of all fermentation, which I then looked on as neceffary; and their extreme corrofivenefs. But the experience of two different fummers, in two different bleachfields, has convinced me, that they will anfwer all the purpofes of the milk and bran fours; nay, in feveral refpects, be much preferable to them. I have feen many pieces of fine cloth, which had no other fours but thofe of vitriol, and were as white and ftrong as thofe bleached in the common way. I have cut feveral webs through the middle, and bleached one half with milk, and the other with vitriol; gave both the fame number of operations, and the latter were as white and ftrong as the former."

The method in which it has been hitherto ufed is this. The proportion of the oil of vitriol to the water, with which it is diluted, is half an ounce, or at moft three quarters, to a gallon of water. As the milk-fours are diminifhed in ftrength, fo ought the vitriol-fours. The whole quantity of the oil of vitriol to be ufed, may be firft mixed with a fmall quantity of water, then added to the whole quantity of water, and well mixed together. The water fhould be milk-warm; by which means the acid particles will penetrate further, and operate fooner. The cloth fhould then be put dry into the liquor.

It is obferved, that this four performs its tafk much fooner than thofe of milk and bran; fo that Mr John Chryftie, in making the trial, ufed to lay the milk-fours twenty-four hours before the vitriol. Five hours will do as much with this four, as five days with the common fort. But the cloth can receive no harm in allowing it to remain for fome days in the four; but rather, on the contrary, an advantage. The cloth is then taken out, well rinfed, and mill-wafhed in the ordinary way.

The liquor, while the cloth lies in this four, is lefs acid the fecond day than the firft, lefs the third than the fecond, and fo diminifhes by degrees. At firft it is clear, but by degrees a mucilaginous fubftance is obferved to float in it; when put into a glafs. This foulnefs increafes every day. This fubftance, extracted by the acid, is the fame with what is extracted by the alkaline falts, and blunts the acidity of the former, as it does the alkalefcency of the latter. Hence the liquor lofes by degrees its acidity. But as the acid falts do not unite fo equally with oily fubftances as the alkaline do, the liquor is not fo uniformly tinged in the former as in the latter cafe, and the mucous fubftance prefents itfelf floating in it.

It is obferved, that, in the firft fouring, which is the ftrongeft, the liquor, which was a pretty ftrong acid before the cloth was put in, immediately afterwards becomes quite vapid; a proof how very foon it performs its tafk. But in the following operations, as the linen advances in whitenefs, the acidity continues much longer; fo that in the laft operations the liquor lofes very little of its acidity. This happens although the firft buckings, after the firft fourings, are increafed in ftrength, while the fours are diminifhed. There are two caufes to which this is owing. The texture of the cloth is now fo opened, that although the lyes are ftrong, the alkaline falts and abforbent earth are eafily wafhed out; and the oily particles are, in a great meafure, removed which help to blunt the acidity of the liquor.

Two objections are made againft the ufe of vitriol-fours. One is, that the procefs of fouring with milk is performed by a fermentation; and, as there is no fermentation in the vitriol-fours, they cannot ferve the purpofe fo well: The other, that they may hurt the texture of the cloth. The anfwer to the former objection is very fhort; that the vitriol-fours operate fuccefsfully without a fermentation, as experience fhews; and therefore in them a fermentation is not neceffary.

As to the latter objection, that oil of vitriol, being a very corrofive body, may hurt the cloth; that will vanifh likewife, when it is confidered how much the vitriol is diluted with water, that the liquor is not ftronger than vinegar, and that it may be fafely taken into the human body.

That it may be ufed with fafety, much ftronger than what is neceffary in the bleachfield, appears from the following experiment with regard to the ftamping of linen. After the linen is boiled in a lye of afhes, it is bleached for fome time. After this, in order to make it receive the colour, it is fteeped in a four of water and oil of vitriol, about fifteen times ftronger than that made ufe of in the bleachfield; for, to 100 gallons of water are added two and a half of oil of vitriol. Into this quantity of liquor, made fo warm as the hand can juft be held in it, is put feven pieces of 28 yards each. The linen remains in it about two hours, and comes out remarkably whiter. The fine cloth often undergoes this operation twice. Nor is there any danger if the oil of vitriol is well mixed with the water. But if the two are not well mixed together, and the oil of vitriol remains in fome parts undiluted, the cloth is corroded into holes.

Let us now take a view of the advantages which the vitriol-fours muft have over the milk. The latter is full of oily particles, fome of which muft be left in the cloth: But the cafe is worfe when the fcum is allowed to precipitate upon the cloth. The former is liable to neither of thefe objections.

The common fours haften very faft to corruption; and if, from want of proper care, they ever arrive at that ftate, muft damage the cloth very much. As the milk is kept very long, it is often corrupted before it is ufed; and, without acting as a four, has all the bad effects of putrefaction. The vitriol-fours are not fubject to putrefaction.

The milk takes five days to perform its tafk, but the vitriol-

vitriol-fours do it in as many hours; nay, perhaps as many minutes. Their junction with the abforbent particles in the cloth muft be immediate, whenever thefe acid particles enter with the water. An unanfwerable proof that the fact is fo, arifes from the circumftances which happen when the cloth is firft fteeped in the vitriol-four; the cloth has no fooner imbibed the acid liquor than it lofes all acidity, and becomes immediately vapid. This effect of vitriol-fours muft be of great advantage in the bleachfield, as the bleachers are at prefent hindered from enjoying the feafon by the tedioufnefs of the fouring procefs. The whole round of operations takes feven days; to anfwer which they muft have feven parcels, which are often mixing together, and caufing miftakes. As three days, at moft, will be fufficient for all the operations when vitriol-fours are ufed, there will be no more than three parcels. The cloth will be kept a fhorter time in the bleachfield, and arrive fooner at market.

The milk-fours are very dear, and often difficult to be got: but the vitriol are cheap, may be eafily procured, and at any time.

There is yet another advantage in the ufe of vitriol, and that is its power of whitening cloth. Even in this diluted ftate, its whitening power is very confiderable. We have already feen, that it removes the fame colouring particles, which the alkaline lyes do. What of it then remains, after the alkaline and abforbent particles are neutralized in the cloth, muft act on thefe colouring particles, and help to whiten the cloth. That this is really the cafe, appears from the following fact. Mr Chryftie being obliged to chufe twenty of the whiteft pieces out of a hundred, five of the twenty were taken out of feven pieces which were bleached with vitriol.

From both experience and reafon, it appears, that it would be for the advantage of our linen-manufacture to ufe vitriol in place of milk-fours.

Hand-rubbing *with Soap and Warm Water*, Rubbing-boards, Starching, *and* Bluing.

After the cloth comes from the fouring, it fhould be well wafhed in the wafhing-mill, to take off all the acid particles which adhere to its furface. All acids decompofe foap, by feparating the alkaline falts and oily parts from one another. Were this to happen on the furface of the cloth, the oil would remain; nor would the wafhing-mill afterwards be able to carry it off.

From the wafhing-mill the fine cloth is carried to be rubbed by womens hands, with foap and water. As the liquors, which are generally employed for fouring, are impregnated with oily particles, many of thefe muft lodge in the cloth, and remain, notwithftanding the preceding milling. It is probable, that all the heavy oils are not evaporated by bleaching. Hence it becomes neceffary to apply foap and warm water, which unite with, diffolve, and carry them off. It is obferved, that if the cloth, when it is pretty white, gets too much foap, the following bleaching is apt to make it yellow; on that account they often wring out the foap.

It is a matter worth inquiring into, whether hard or foft foap is beft for cloth. Moft bleachers agree, that hard foap is apt to leave a yellownefs in the cloth. It is faid, that the ufe of hard foap is difcharged in Holland. As there muft be a confiderable quantity of fea-falt in this kind, which is not in the foft, and as this falt appears prejudicial to cloth, the foft foap ought to be preferred.

The management of the coarfe cloth is very different, in this operation, from fine. Inftead of being rubbed with hands, which would be too expenfive, it is laid on a table, run over with foap, and then put betwixt the rubbing-boards, which have ridges and grooves from one fide to another, like teeth. Thefe boards have fmall ledges to keep in the foap and water, which faves the cloth. They are moved by hands, or a water-wheel, which is more equal and cheaper. The cloth is drawn, by degrees, through the boards, by men who attend; or, which is more equal and cheaper, the fame water-wheel moves two rollers, with ridge and groove, fo that the former enters the latter, and, by a gentle motion round their own axis, pull the cloth gradually through the boards.

This mill was invented in Ireland about thirty years ago. The Irifh bleachers ufe it for their fine, as well as coarfe cloath. Thefe rubbing-boards were difcharged, fome years ago, in Ireland, by the Truftees for the manufactures of that country, convinced from long experience of their bad effects. But as proper care was not taken to inftruct the bleachers by degrees in a fafer method, they continued in the old, made a party, and kept poffeffion of the rubbing-boards. There were confiderable improvements made in them in this country; fuch as the addition of the ledges, to keep the cloth moift; and of the rollers, which pull the cloth more gradually than mens hands. Thefe improvements were firft made in Salton bleachfield.

The objections againft thefe rubbing-boards, are unanfwerable. By rubbing on fuch an unequal furface, the folid fibrous part of the cloth is wore; by which means it is much thinned, and in a great meafure weakened before it comes to the market. As a proof of this, if the water which comes from the cloth in the rubbing-boards be examined, it will be found full of cottony fibrous matter. Thefe boards give the cloth a cottony furface, fo that it does not keep long clean. Again, they flatten the threads, and take away all that roundnefs and firmnefs, which is the diftinguifhing property of cloth bleached in the Dutch method.

For thefe reafons they muft be very prejudicial to fine cloth, and fhould never be ufed in bleaching it. As they feem to be, in fome meafure, neceffary to leffen the expence of bleaching coarfe linen, they ought never to be ufed above twice, or thrice at moft. They might be rendered much more fafe, by lining their infides with fome foft elaftic fubftance, that will not wear the cloth fo much as the wooden teeth do. Mr Chryftie at Perth has lined his boards with fhort hair for fome years paft, and finds that it anfwers very well.

After the coarfe linen has undergone a rubbing, it fhould be immediately milled for an hour, and warm water poured now and then on it to make it lather. This milling has very good effects; for it cleans the cloth of all

all the dirt and filth which the rubbing-boards have loosened, and which, at the next boiling, would discolour the cloth. Besides, it is observed, that it makes the cloth less cottony, and more firm, than when whitened by rubbing alone.

The last operation is that of starching and bluing. It often happens, that the cloth, when exposed to the weather to be dried after this operation, gets rain; which undoes all again, and forces the bleacher to a new expence. To remedy this inconvenience, Mr Chrystie, some years ago, invented the dry-house, where the cloth may be dried, after this operation, in any weather. This invention meets with universal approbation.

A METHOD OF BLEACHING SAFELY WITH LIME.

Dr Home has found by repeated trials, that alkaline salts added to lime, diminish its power of weakening and corroding cloth; and that in proportion to the quantity of these salts added to the lime. This composition, as it is not so dangerous as lime alone, so it is not so expeditious in whitening. When equal parts of each are used, the whitening power is strong, and the weakening power not very considerable; so that they might be used with safety to bleach cloth, in the proportion of one part of lime to four of pure alkaline salts. This fully accounts for an observation made by all bleachers, That the bleaching salts, when mixed together, operate safer and better than when used separately. For the corrosive power of the Muscovy, Marcost, and Cashub ashes is corrected by the pearl ashes. and the whitening quality of the latter is increased by that of the former.

There is not a more corroding substance, with regard to animals, than alkaline salts and lime joined together, especially when fused in the fire. This is the composition of the common caustic. But lime, and lime-water alone, preserve animal substances in a sound entire state. It appears then surprising, that salts and lime should be found so little destructive of cloth, when lime, or lime-water alone, destroys it so remarkably. But that this is a fact, is made evident by many experiments, and has been practised both with success and safety, by a bleacher who gives the following account of his method of bleaching with lime.

" First, says he, I steep the cloth in warm water for twenty-four hours; then clean it in a washing mill, of all the dressing, or sowen, as the vulgar term it. Afterwards I buck the cloth with cow-dung and water, and bleach it with this for three days; then clean it again, and boil it with a lye made of Cashub ashes. A pound to each piece of 18 or 20 yards long is sufficient. This I do twice, as no lime ought to be given to cloth before it is a full third whitened; it by no means advances the whitening of the cloth, but, on the contrary, protracts it: For, instead of loosening the oil and dirt in the cloth, when brown, it rather fixes them; just as when fine cloth is bucked with over-warm lyes in the first buckings. Lime is by no means fit for discharging the oil in the cloth, but for cleaning it of the dead part, commonly called *sprat*. The cloth, being cleaned, is laid upon a dreeper. It must not be drier before bucking with lime, otherwise it will take in more than can be got out again before the next application: For as I have observed already, that lime is only fit for discharging the dead part, bucking thus wet make it rest on the outside of the cloth. I take a lippy of the finest and richest powdered lime that can be got, of the brightest white colour, as poor lime does more hurt than good, to thirty pieces of the above length; and make a cold lye of it, by stirring and pouring water off the lime, until all be dissolved, but the dross, which is thrown away: Then I add a little soap, which makes the lye have the nearest resemblance to milk that breaks in boiling, of any thing I can think of: For this soap blunts the hotness of the lime. Then I take the cloth, and dip it in the lime-lye; and that moment out again, and lay it on a dreeper until it be bucked; then put it on the field, watering it carefully; for if allowed to dry, it is much damaged. This is done always in the morning; as it cannot be done at night, in regard of the hot quality of the lime, which soon heats the cloth, and tenders it. If a hot sunshine follows, it has great effect: for lime is just like all other materials for bleaching, that have more or less effect according as the weather is good or bad. I take it up the second day after bucking, and give it a little milling, or hand-bleaching, or bittling, commonly called *knocking*; and lay it on the field again, watering it carefully as before. The effect is more visible the second than the first day. As all cloth when limed should have a great deal of work, otherwise more than half the effect is lost; and not only that, but a great deal of labour and pains is requisite to take the lime out of the cloth again; it must never be exposed on the Sabbath day, but carefully kept wet always while used in this way. Thus bucking for three or four times at most, is sufficient for any cloth, except that made of flax pulled either over-green, or which grows in a droughty season, or perhaps not so well heckled as it should be. This sort occasions great trouble and expence to the bleacher. But the most effectual and expeditious way I ever found for this kind, was, after boiling, to take a little of the warm lye, and mix a very small quantity of lime with it, and draw the cloth through that as hot as possible, and put it on the field directly, watering it carefully. This will clean it of the sprat surprisingly. Then I boil it with pearl ashes, and give it the last boil with soap.

" There are innumerable mistakes in the use of lime committed by the vulgar, who are ignorant of its quality and effects. They know only this in general, that it is a thing which whitens cloth cheap, and is easy purchased; therefore they will use it. Some of them begin whitening of their cloth with it, which I have already observed to be wrong, and given reasons for it, and continue it until the cloth is bleached; give it a boil or two at most, and then wash it up while the gross body of the lime is in the substance of the cloth. This makes limed cloth easily distinguishable from unlimed, as the former has a yellowish colour, and is full of a powder. Besides, as lime is of a very hot corroding nature, it must by degrees weaken the cloth. The bad effects of this substance do not end here. When the cloth is put on board, it contracts

tracts a dampnefs, which not only makes it yellow, and lofes any thing of colour it has, but directly rots it. And although it fhould efcape this, which it is poffible it may, by a quick and fpeedy paffage; yet whenever it is put in any warehoufe, it will meet with moifture there, efpecially if the winter-feafon fhould come on before it is difpofed or made ufe of. Thefe I take to be the principal reafons for fo much complaint in bleaching with this material."

The whole art and fafety in ufing the lime, according to this method, depends on the junction of the alkaline falts, during the bucking, to the particles of lime which were on the furface of the cloth.

BLEAK, the Englifh name of the fifh called cyprinus. See CYPRINUS.

BLECHINGLY, a borough-town of Surry, about twenty miles fouth of London; W. long. 20′, and N. lat. 51° 20′.

BLECHNUM, in botany, a genus of the cryptogamia filices. The feeds and parts of fructification of this fern lie in fmall lines under the plaits of the leaves. The fpecies are two, *viz.* the occidentale, a native of America; and the occidentale, a native of China.

BLEEDING, in furgery. See SURGERY.

BLEEDING at the nofe. See HEMORRHAGE, and MEDICINE.

BLEEDING is alfo ufed for the drawing out the fap of plants, otherwife called tapping. See TAPPING.

BLEKING, the moft fouth-eafterly province of Sweden, having the Baltic on the fouth, Smaland on the north, and the province of Schonen on the weft.

BLEMISH, a term in hunting, when the hounds or beagles finding where the chace has been, make a proffer to enter, but return.

BLEMYES, or BLEMMYES, a fabulous people of Ethiopia, faid to have had no heads; their eyes, mouth, *&c.* being fituated in their breafts.

BLENCH or BLANCH. See BLANCH.

BLEND, or BLENDE, a mineral fubftance refembling lead-ore, but containing very little of that metal.

BLEND-WATER, called alfo *morehough*, a diftemper incident to black cattle, comes either from the blood, from the yellows, or from the change of ground.

In order to cure it, take bole armoniac, and as much charcoal duft as will fill an egg-fhell, a good quantity of the inner bark of an oak, dried and pounded together to a powder, and give it to the beaft in a quart of new milk and a pint of earning.

BLENHEIM, a village of Swabia in Germany, fituated on the weft fide of the Danube, three miles north-eaft of Hockftet, and twenty-feven miles north-eaft of Ulm; E. long. 10° 25′, N. lat. 48° 40′.

BLENNIUS, in ichthyology, a genus of fifhes belonging to the order of jugulares; the characters of which are thefe: The head flants or declines to one fide; there are fix rays in the membrane of the gills; the body tapers toward the tail; the belly-fins have only two blunt bones; and the tail-fin is diftinct. The fpecies are 13, *viz.* 1. The galeria, with a tranfverfe membranous creft upon the head. It is found in the European feas. 2. The criftatus, with a longitudinal briftly creft betwixt the eyes. 3. The cornutus, with a fimple ray above the eyes, and a fingle back-fin. The above two are natives of the Indies. 4. The ocellaris, with a furrow betwixt the eyes, and a large fpot on the back-fin. 5. The gattorugine, with fmall palmated fins about the eye-brows and neck. It is about feven or eight inches long. Thefe two laft are found in the European feas. 6. The fuperciliofus, with fmall fins about the eye-brows, and a curved lateral line. It is a native of India. 7. The phycis, with a kind of crefted noftrils, a cirrus or beard on the under lip, and a double fin on the back. It has feven rays in the gill-membrane; the anus is furrounded with a black ring; and the tail is roundifh. 8. The pholis has a fmooth head, a curve line upon the fides, and the upper jaw is larger than the under one. The two laft are found in the Mediterranean fea. 9. The gunnellus has 10 black fpots on the back-fin. It is found in the Atlantic Ocean. 10. The muftelaris has three rays on the fore-part of the back-fin. It is a native of India. 11. The viviparus has two tentacula at the mouth. 12. The lumpenus has feveral dufky-coloured areolæ running acrofs its body. The two laft are found in the European feas. 13. The raninus, with fix divifions in the belly-fins. It is found in the lakes of Sweden. It is remarkable, that when this fifh appears in the lake, all the other fifhes retire; and what is worfe, it is not fit for eating.

BLEYME, an inflammation arifing from bruifed blood between a horfe's fole and the bone of the foot, towards the heel. Of thefe there are three forts: The firft being bred in fpoiled wrinkled feet, with narrow heels, are ufually feated in the inward or weakeft quarter. In this cafe the hoof muft be pared, and the matter let out; then let oil *de merveille* be poured in, and the hoof be charged with a remolade of foot and turpentine.

The fecond fort, befides the ufual fymptoms of the firft, infects the griftle, and muft be extirpated, as in the cure of a quitter bone, giving the horfe, every day, moiftened bran, with two ounces of liver of antimony, to divert the courfe of the humours, and purify the blood.

The third fort of bleymes, is occafioned by fmall ftones and gravel between the fhoe and the fole. In this cafe the foot muft be pared, and the matter, if any, let out: If there be no matter, then the bruifed fole muft be taken out; but if there be matter, the fore muft be dreffed like the prick of a nail.

BLIGHT, in hufbandry, a difeafe incident to plants, which affects them varioufly, the whole plant fometimes perifhing by it, and fometimes only the leaves and

and bloſſoms, which will be ſcorched and ſhrivelled up, the reſt remaining green and flouriſhing.

Some have ſuppoſed that blights are uſually produced by an eaſterly wind, which brings vaſt quantities of inſects eggs along with it, from ſome diſtant place, that, being lodged upon the ſurface of the leaves and flowers of fruit-trees, cauſe them to ſhrivel up and periſh.

To cure this diſtemper, they adviſe the burning of wet litter on the windward ſide of the plants, that the ſmoke thereof may be carried to them by the wind, which they ſuppoſe will ſtifle and deſtroy the inſects, and thereby cure the diſtemper.

Others direct the uſe of tobacco-duſt, or to waſh the trees with water wherein tobacco-ſtalks have been infuſed for twelve hours; which they ſay will deſtroy thoſe inſects, and recover the plants.

Pepper-duſt ſcattered over the bloſſoms of fruit-trees, *&c.* has been recommended as very uſeful in this caſe; and there are ſome that adviſe the pulling off the leaves that are diſtempered.

The true cauſe of blights ſeems to be continued dry eaſterly winds for ſeveral days together, without the intervention of ſhowers, or any morning dew, by which the perſpiration in the tender bloſſom is ſtopped; and if it ſo happens, that there is a long continuance of the ſame weather, it equally affects the tender leaves, whereby their colour is changed, and they wither and decay.

The beſt remedy for this diſtemper, is gently to waſh and ſprinkle over the tree, *&c.* from time to time with common water; and if the young ſhoots ſeem to be much infected, let them be waſhed with a woollen cloth, ſo as to clear them, if poſſible, from this glutinous matter, that their reſpiration and perſpiration may not be obſtructed. This operation ought to be performed early in the day, that the moiſture may be exhaled before the cold of the night comes on: Nor ſhould it be done when the ſun ſhines very hot.

Another cauſe of blights in the ſpring, is ſharp hoary froſts, which are often ſuceeded by hot ſunſhine in the day time: This is the moſt ſudden and certain deſtroyer of the fruits that is known.

BLIGHTED *corn.* See SMUT.

BLIND. See BLINDNESS.

Pore-BLIND, or *pur*-BLIND. A perſon who is very ſhort-ſighted is ſaid to be *pur-blind.*

Moon-BLIND, denotes horſes that loſe their ſight at certain times of the moon.

BLIND is alſo uſed figuratively, for things without apertures; Thus we ſay, *a blind wall, a blind alembic*, &c.

BLIND, among traders, a kind of falſe light which they have in their warehouſes and ſhops, to prevent too great a light from diminiſhing the luſtre of their ſtuffs.

BLIND, BLINDE, or BLEND. See BLEND.

BLINDS, or BLINDES, in the art of war, a ſort of defence commonly made of oziers, or branches interwoven, and laid acroſs, between two rows of ſtakes, about the height of a man, and four or five feet aſunder, uſed particularly at the heads of trenches, when they are extended in front towards the glacis; ſerving to ſhelter the workmen, and prevent their being overlooked by the enemy.

BLINDNESS, a total privation of ſight, ariſing from an obſtruction of the functions of the organs of ſight, or from an intire deprivation of them. See MEDICINE, *Of the gutta ſerena*, &c.

BLINDNESS, in farriery. When a horſe becomes blind, it may be thus diſcerned: His walk or ſtep is always uncertain and unequal, ſo that he does not ſet down his feet boldly when led in one's hand: But if the ſame horſe be mounted by an expert horſeman, and if he be a beaſt of metal, then the fear of the ſpurs will make him go reſolutely and freely; ſo that his blindneſs can hardly be perceived.

BLISTER, in medicine, a thin bladder containing a watery humour, whether occaſioned by burns, and the like accidents, or by veſicatories applied to different parts of the body for that purpoſe.

Cantharides, or Spaniſh flies, applied in the form of a plaſter, are chiefly uſed with this intention. See CANTHARIDES.

BLITE, in botany. See BLITUM.

BLITH, a market-town in Nottinghamſhire, about 18 miles north-weſt of Newark; in 1° W. long. and 53° 25′ N. lat.

BLITUM, in botany, a genus of the monandria digynia claſs. The calix conſiſts of three ſegments; there are no petals; and the ſeed, which is ſingle, is incloſed in the calix, which becomes a kind of berry. The ſpecies are two; *viz.* the capitatum, a native of Tyrol; and the virgatum, a native of Tartary and Spain.

BLOATING, among phyſicians. See EMPHYSEMA.

BLOCK, a large maſs of wood, ſerving to work or cut things on.

BLOCKS, on ſhip-board, is the uſual name of what we call pulleys at land. They are thick pieces of wood, ſome with three, four, or five ſhivers in them, through which all the running ropes run. Blocks, whether ſingle or double, are diſtinguiſhed and called by the names of the ropes they carry, and the uſes they ſerve for.

Double blocks are uſed when there is occaſion for much ſtrength, becauſe they will purchaſe with more eaſe than ſingle blocks, though much ſlower.

Block and block is a phraſe ſignifying that two blocks meet, in haling any tackle, or halliard, having ſuch blocks belonging to them.

Fiſh-block is hung in at a notch at the end of the davit. It ſerves to hale up the flooks of the anchor at the ſhip's prow.

Snatch-block is a great block with a ſhiver in it, and a notch cut through one of its cheeks, for the more ready receiving of any rope; as by this notch the middle-part of a rope may be reeved into the block, without paſſing it endwiſe. It is commonly faſtened with a ſtrap about the main-maſt, cloſe to the upper deck, and is chiefly uſed for the fall of the winding tackle, which is reeved into this block, and then brought to the capſtan.

BLOCK, among bowlers, denotes the ſmall bowl uſed as a mark.

BLOCK, in falconry, the perch upon which they place the hawk. It ought to be covered with cloth.

BLOCKADE, in the art of war, the blocking up a place,

place, by posting troops at all the avenues leading to it, to keep supplies of men and provisions from getting into it; and by these means proposing to starve it out, without making any regular attacks.

To raise a blockade, is to force the troops that keep the place blocked up, from their posts.

BLOIS, a beautiful city of Orleanois, about 30 miles south-west of Orleans; situated on the north shore of the river Loire, in one of the finest countries in France; in 1° 20′ E. long. and 47° 35′ N. lat.

BLOMARY, or BLOOMARY, in metallurgy, the first forge through which iron passes, after it is melted out of the ore.

BLONIC, a town of Poland, about 20 miles west of Warsaw; in 20° 30′ E. long. and 52°. N. lat.

BLOOD, a well known fluid, which circulates through the arteries, veins, &c. of animal-bodies, and nourishes all their parts.

Blood is composed of a thin watery liquor called *serum*, and a thick red part called *crassamentum*, which, when viewed by the microscope, appears to consist of red globules of a certain determined magnitude. These globules are generally believed to be of the same magnitude in all animals that have red blood.

As blood is originally derived from our aliment, it must consist of the same principles, and consequently abound with salts and oils. The salts of the blood are partly of the fixed neutral kind, and partly such as are rendered semi-volatile by the heat and motion to which they are subjected: Both irritate the sensible nervous parts of animals; for it is well-known that any kind of salt applied to the eye gives great uneasiness. From these qualities of blood the late learned and celebrated Dr Whytt concluded that it must be well fitted to communicate a gentle stimulus to those sensible nerves which terminate on the internal surface of the auricles and ventricles of the heart; and consequently that the contraction of the heart is principally owing to this cause. The diameter of a red globule is computed to be about $\frac{1}{1000}$ part of an inch. See CIRCULATION; and for the analysis of blood, see CHEMISTRY.

Authors are not agreed in regard to the quantity of blood contained in the human body; some making it only 10 pounds, whilst others make it to be 20, 60, or even 100 pounds: But then these last comprehend the juices of the lymphatic vessels under the term blood. As to the quantity of current blood in a horse, the ingenious Dr Hales found it be, at a low computation, 1105 cubic inches, or 42.2 pounds.

Spitting of BLOOD. See HÆMOPTOE and MEDICINE.

Ebullition of the BLOOD, a disease in horses, which proceeds from want of exercise, and gives rise to outward swellings, frequently mistaken for the farcin.

BLOOD *running itch* happens to a horse by the blood's being over-heated by hard riding or other labour. As the blood gets between the skin and the flesh, it makes a horse rub and bite himself, and if neglected will turn to a grievous mange.

BLOOD *of Christ*, the name of a military order instituted at Mantua in 1608. The number of knights was restricted to twenty, besides the grand master. Their device was, *Domine probasti me*, or, *Nihil hoc, triste, recepto.*

BLOOD *of Christ* is also the name of a congregation of nuns at Paris.

Dragon's BLOOD. See DRAGON.

BLOOD-*snake*. See ANGUIS.

BLOOD-*stone*. See HÆMATITES.

BLOOD-*wit*, a mulct or fine for shedding of blood.

BLOOD-*wort*, in botany. See SANGUINARIA.

BLOODY-*flux*. See DYSENTERY, and MEDICINE.

BLOOM, a mass of iron after having undergone the first hammering, called blomary. See BLOMARY.

BLOSSOM denotes the flowers of plants, but more especially of fruit-trees.

BLOSSOM, or PEACH-COLOURED, in the menage, a term applied to a horse that has his hair white, but intermixed all over with sorrel and bay hairs. Such horses are so insensible and hard both in the mouth and the flanks, that they are scarce valued; besides, they are apt to turn blind.

BLOW, in law, any kind of stroke, whether given with the hand or a weapon. See BATTERY.

BLOW-*pipe*, or BLOWING *pipe*, a hollow tube, used by several artificers; as enamellers, glass-makers, &c.

BLOWING, in a general sense, denotes an agitation of the air, whether performed with a pair of bellows, the mouth, a tube, or the like.

BLOWING *of glass*, one of the methods of forming the divers kinds of works in the glass-manufacture. See GLASS.

It is performed by dipping the point of an iron blowing-pipe in the melted glass, and blowing through it with the mouth, according to the circumstances of the glass to be blown.

BLOWING *of tin* denotes the melting its ore, after being first burnt to destroy the mundic.

BLOWING, among gardeners, the same with the blossoming of plants, or putting forth their flower-leaves.

BLUBBER denotes the fat of whales and other large sea-animals, whereof is made train-oil.

BLUE, otherwise called *azure*, is one of the primitive colours of the rays of light. See OPTICS.

Painters BLUE is made different according to the different kinds of painting. In limning, fresco, and miniature, they use indifferently ultramarine, blue-ashes, and smalt: These are their natural blues, excepting the last, which is partly natural, and partly artificial.

In oil and miniature, they also use indigo prepared; as also a fictitious ultramarine. See ULTRAMARINE and INDIGO.

Enamellers, and painters upon glass, have also blues proper to themselves, each preparing them after their own manner.

Turnsole BLUE is used in painting on wood, and is made of the seed of the turnsole: The way of preparing it is, to boil four ounces of turnsole in a pint and half of water in which lime has been slacked.

Flanders BLUE is a colour bordering on green, and seldom used but in landskips.

To

To write on paper or parchment with Blue-*ink*. Grind blue with honey, then temper it with glair of eggs, or gum made of iſinglaſs.

Blueing *of metals* is performed by heating them in the fire, till they aſſume a blue colour; particularly practiſed by gilders, who blue their metals before they apply the gold and ſilver leaf.

To dye ſkins Blue. Boil elder-berries or dwarf-elder, then ſmear and waſh the ſkins therewith, and wring them out; then boil the berries, as before, in a ſolution of alum-water, and wet the ſkins in the ſame manner once or twice; dry them, and they will be very blue.

Dyers Blue is one of their ſimple or mother-colours, uſed in the compoſition of others. It is made of woad, indigo, and a paſtel brought from Normandy. Some dyers heighten their blue, by adding Braſil and other woods.

A Blue *for painting or ſtaining of glaſs*. Take fine white ſand twelve ounces, zaffer and minium of each three ounces; reduce them to a fine powder in a bell-metal mortar; then putting the power into a very ſtrong crucible, cover it and lute it well, and, being dry, calcine it over a quick fire for an hour; take out the matter and pound it; then to ſixteen ounces of this powder add fourteen of nitre powder; mix them well together, and put them into the crucible again; cover and lute it, and calcine for two hours on a very ſtrong fire.

Pruſſian Blue. This blue is next to ultramarine for beauty, if it be uſed in oil: This colour does not grind well in water.

Blue *bice* is a colour of good brightneſs, next to Pruſſian blue; and alſo a colour of a body, and will flow pretty well in the pencil.

Saunders Blue is alſo of very good uſe, and may ſerve as a ſhade to ultramarine or the blue bice, where the ſhades are not required to be very deep, and is of itſelf a pleaſant blue, to be laid between the light and ſhades of ſuch a flower as is of a mazarine blue.

A fine Blue *from Mr Boyle*. Take the blue leaves of rue, and beat them a little in a ſtone mortar with a wooden peſtle; then put them in water, juice and all, for fourteen days or more, waſhing them every day till they are rotten; and at laſt beat them and the water together, till they become a pulp, and let them dry in the ſun. This is a fine blue for ſhading.

Indigo-Blue. This makes the ſtrongeſt ſhade for blues of any other, and is of a ſoft warm colour, when it has been well ground, and waſhed with gum-water, by means of a ſtone and a muller.

Lacmus, or *Litmus* Blue. This is a beautiful blue, and will run in a pen as free as ink. It is made of lacmus, and prepared thus: Take an ounce of lacmus, and boil it in a pint of ſmall-beer wort, till the colour is as ſtrong as you would have it; then pour off the liquor into a gallipot, and let it cool for uſe. This affords a beautiful colour, has extraordinary effects, and is a holding colour; if it be touched with aqua-fortis, it immediately changes to a fine crimſon, little inferior to carmine.

Blue-*Japan*. Take gum-water, what quantity you pleaſe, and white lead a ſufficient quantity; grind them well upon a porphyry; then take iſinglaſs ſize what quantity you pleaſe, of the fineſt and beſt ſmalt a ſufficient quantity, mix them well; to which add, of your white lead, before ground, ſo much as may give it a ſufficient body; mix all theſe together to the conſiſtence of a paint.

Blue-*bottle*, in botany. See Cyanus.

Blue-*cap*, in ichthyology. See Salmo.

Blue-*mantle*, in heraldry, the title of a pourſuivant at arms.

BLUFF-HEAD, among ſailors. A ſhip is ſaid to be bluff-headed, that has an upright ſtern.

BLUNDERBUSS, a ſhort fire-arm with a wide bore, capable of holding a number of bullets at once.

BLUSHING, a ſuffuſion, or redneſs of the cheeks, excited by a ſenſe of ſhame, on account of a conſciouſneſs of ſome failing or imperfection.

B MI, in muſic, the third note in the modern ſcale. See Scale and Music.

B MOLLARRE, or Molle, one of the notes of the ſcale of muſic, uſually called ſoft or flat, in oppoſition to b quandro. See B Quandro.

BOA, in zoology, a genus of ſerpents, belonging to the order of amphibia. The characters of this genus are, that the belly and tail are both furniſhed with ſcuta. The ſpecies are ten, *viz.* 1. The contortrix, has 150 ſcuta on the belly, and 40 on the tail; the head is broad, very convex, and has poiſon-bags in the mouth, but no fang, for which reaſon its bite is not reckoned poiſonous: The body is aſh-coloured, interſperſed with large duſky ſpots; and the tail is about a third of the length of the body. This ſerpent is found in Carolina. 2. The canina, has 203 ſcuta on the belly, and 77 on the the tail; it is greeniſh, and variegated with white belts. It is a native of America, and lodges in the hollow trunks of trees, and is about two feet long. The bite of the canina is not poiſonous. 3. The hipnale, is of a dull yellow colour, and is found in Aſia. It has 179 ſcuta on the belly, and 120 on the tail.—4. The conſtrictor, has 240 ſcuta on the belly, and 60 on the tail. This is an immenſe animal; it often exceeds 36 feet in length; the body is very thick, of a duſky white colour, and its back is interſperſed with 24 large pale irregular ſpots; the tail is of a darker colour; and the ſides are beautifully variegated with pale ſpots. Beſides, the whole body is interſperſed with ſmall brown ſpots. The head is covered with ſmall ſcales, and has no broad laminæ betwixt the eyes, but has a black belt behind the eyes. It wants the large dog-fangs, and of courſe its bite is not poiſonous. The tongue is fleſhy, and very little forked. Above the eyes, on each ſide, the head riſes high. The ſcales of this ſerpent are all very ſmall, roundiſh, and ſmooth. The tail does not exceed one eighth of the whole length of the animal. The Indians, who adore this monſtrous animal, uſe the ſkin for cloaths, on account of its ſmoothneſs and beauty. There are ſeveral of theſe ſkins of the above dimenſions preſerved, and to be ſeen in the different muſeums

ſeums of Europe, particularly in the library and botanic garden of Upſal in Sweden, which has of late been greatly enriched by count Grillinborg. The fleſh of this ſerpent is eat by the Indians, and the negroes of Africa. Piſo, Margraave, and Kempfer give the following account of its method of living and catching its prey. It frequents caves and thick foreſts, where it conceals itſelf, and ſuddenly darts out upon travellers, wild beaſts, *&c.* When it chuſes a tree for its watching-place, it ſupports itſelf by twiſting its tail around the trunk or a branch, and darts down upon ſheep, goats, tigers, or any animal that comes within its reach. When it lays hold of animals, eſpecially any of the larger kinds, it twiſts itſelf ſeveral times round their body, and, by the vaſt force of its circular muſcles, bruiſes and breaks all their bones. After the bones are broke, it licks the ſkin of the animal all over, beſmearing it with a glutinous kind of ſaliva. This operation is intended to facilitate deglutition, and is a preparation for ſwallowing the whole animal. If it be a ſtag, or any horned animal, it begins to ſwallow the feet firſt, and gradually ſucks in the body, and laſt of all the head. When the horns happen to be large, this ſerpent has been obſerved to go about for a long time with the horns of a ſtag ſticking out from its mouth. As the animal digeſts, the horns putrify and fall off. After this ſerpent has ſwallowed a ſtag or a tyger, it is unable for ſome days to move; the hunters, who are well acquainted with this circumſtance, always take this opportunity of deſtroying it. When irritated, it makes a loud hiſſing noiſe. This ſerpent is ſaid to cover itſelf over with leaves in ſuch places as ſtags or other animals frequent, in order to conceal itſelf from their ſight, and that it may the more eaſily lay hold of them. See Plate LII. fig. 1.—5. The murina, has 254 ſcuta on the belly, and 65 on the tail. The colour of it is a light blue, with round ſpots on the back. It is a native of America, and its bite is not poiſonous. 6. The ſcytale, has 250 ſcuta on the belly, and 70 on the tail. The body is aſh-coloured and bluiſh, with round black ſpots on the back, and black lateral rings edged with white. This ſerpent is a native of America; and, like the conſtrictor, though not ſo long, twiſts itſelf about ſheep, goats, *&c.* and ſwallows them whole. 7. The cenchria, has 265 ſcuta on the belly, and 57 on the tail. It is of a yellow colour, with white eye-like ſpots. It is a native of Surinam, and its bite is not poiſonous. 8. The ophrias, has 281 ſcuta on the belly, and 64 on the tail; the colour is nearly the ſame with that of the conſtrictor, but browner. The place where this ſerpent is to be found is not known; but its bite is not venomous. 9. The enydris, has 270 ſcuta on the belly, and 105 on the tail. The colour is a duſky white, and the teeth of the lower jaw are very long; but its bite is not poiſonous. It is a native of America. 10. The hortulana, has 290 ſcuta on the belly, and 128 on the tail. It is of a pale colour, interſperſed with livid wedge-like ſpots. It is a native of America, and its bite is not poiſonous.—For the nature and qualities of ſerpents in general, their method of propagation, *&c.* ſee NATURAL HISTORY.

BOAR, a male ſwine. See SUS.

BOAR, in the menage. A horſe is ſaid to boar, when he ſhoots out his noſe as high as his ears, and toſſes his noſe in the wind.

BOARD, a long piece of timber, ſawed thin for building and ſeveral other purpoſes. See TIMBER.

Barrel-BOARDS, imported from Ireland, Aſia, or Africa, pay only $11\frac{55}{100}$d. the hundred; but if imported from elſewhere, they pay 1 s. $5\frac{17}{100}$d. Clap-boards pay 4 s. $9\frac{52}{100}$d. the hundred; but if imported from Ireland, Aſia, or Africa, only 2 s. $10\frac{65}{100}$d. Pipe-boards pay 5 s. $8\frac{70}{100}$d. the hundred; but if from Ireland, *&c.* only 3 s. $10\frac{20}{100}$d Scale-boards pay 8 s. $5\frac{45}{100}$d. the hundred weight; and $\frac{1}{2}$d. more if imported in foreign bottoms.

BOARD, among ſeamen. *To go aboard*, ſignifies to go into the ſhip. *To ſlip by the board*, is to ſlip down by the ſhip's ſide. *Board and board*, is when two ſhips come ſo near as to touch one another, or when they lie ſide by ſide. *To make a board*, is to turn to windward; and the longer your boards are, the more you work into the wind. *To board it up*, is to beat it up, ſometimes upon one tack, and ſometimes upon another. *She makes a good board*, that is, the ſhip advances much at one tack. *The weather-board*, is that ſide of the ſhip which is to windward.

BOARD is alſo uſed for an office under the government: thus we ſay, the board of trade and plantations, the board of works, ordnance, *&c.*

BOARDING *a ſhip*, is entering an enemy's ſhip in a fight.

In boarding a ſhip, it is beſt to bear up directly with him, and to cauſe all your ports to leeward to be beat open; then bring as many guns from your weather ſide as you have ports for; and laying the enemy's ſhip, on board, loof for loof, order your tops and yards to be manned and furniſhed with neceſſaries; and let all your ſmall ſhot be in a readineſs; then charge at once with both ſmall and great, and at the ſame time enter your men under cover of the ſmoke, either on the bow of your enemy's ſhip, or bring your midſhip cloſe up with her quarter, and ſo enter your men by the ſhrouds: or if you would uſe your ordnance, it is beſt to board your enemy's ſhip athwart her hawſe; for in that caſe you may uſe moſt of your great guns, and ſhe only thoſe of her prow. Let ſome of your men endeavour to cut down the enemy's yards and tackle, whilſt others clear the decks, and beat the enemy from aloft. Then let the ſcuttles and hatches be broke open with all poſſible ſpeed to avoid trains, and the danger of being blown up by barrels of powder placed under the decks.

BOAT, a ſmall open veſſel, commonly wrought by rowing.

BOATSWAIN, a ſhip-officer, to whom is committed the charge of all the tacklings, ſails, and rigging, ropes, cables, anchors, flags, pendants, *&c.* He is alſo to take care of the long-boat and its furniture, and to ſteer her either by himſelf or his mate.

He

Plate LII.

Fig. 2. Bos

Fig. 1. Boa

A Bell Sculp.

He calls out the ſeveral gangs and companies aboard, to the due execution of their watches, works, ſpells, *&c.* He is likewiſe provoſt-marſhal, who ſees and puniſhes all offenders ſentenced by the captain, or a court-martial of the fleet.

BOATSWAIN's *mate* has the peculiar command of the long boat, for the ſetting forth of anchors, weighing or fetching home an anchor, warping, towing, or mooring; and is to give an account of his ſtore.

BOB, a term uſed for the ball of a ſhort pendulum.

BOBARTIA, in botany, a genus of the triandria digynia claſs. The calix is imbricated; and the corolla conſiſts of a double-valved gluma. There is but one ſpecies, *viz.* the indica, a native of the Indies.

BOBBIN, a ſmall piece of wood turned in the form of a cylinder, with a little border jutting out at each end, bored through to receive a ſmall iron pivot. It ſerves to ſpin with the ſpinning-wheel, or to wind thread, worſted, hair, cotton, ſilk, gold, and ſilver.

BOBBING, a method of fiſhing. See FISHING.

BOBBIO, a town of the Milaneſe, in Italy, about twenty-eight miles ſouth-eaſt of Pavia; E. long. 10°, N. lat. 44° 35′.

BOCA, in ichthyology. See SPARUS.

BOCA-CHICA, the entrance into the harbour of Carthagena, in South America, defended by ſeveral forts.

BOCA DEL DRAGO, a ſtrait between the iſland of Trinidad and New Andaluſia, a province of Terra Firma. See TERRA FIRMA.

BOCARDO, among logicians, the fifth mode of the third figure of ſyllogiſms, in which the middle propoſition is an univerſal affirmative, and the firſt and laſt particular negatives, thus:

BO Some ſickly perſons are not ſtudents;
CAR Every ſickly perſon is pale;
DO Therefore ſome perſons are pale that are not ſtudents.

BOCCONIA, in botany, a genus of the dodecandria monogynia claſs. There is only one ſpecies, *viz.* the fruteſcens, a native of America.

BOCE, in ichthyology. See SPARUS.

BOCHARA, a large town of Uſbec Tartary, ſituated on the river Oxus, about ſixty miles weſt of Samarcand, in 65° E. long. and 40° N. lat.

BOCKHOLT, a town of Munſter, in Weſtphalia, ſituated in 6° 20′ E. long. and 51° 40′ N. lat.

BOCK-LAND, in the Saxons time, is what we now call freehold lands, held by the better ſort of perſons by charter or deed in writing; by which name it was diſtinguiſhed from folkland, or copy-hold land, holden by the common people without writing.

BODKIN, a ſmall inſtrument made of ſteel, bone, ivory, *&c.* uſed for making holes.

The ſmall groſs, or twelve dozen, of bodkins pays on importation 1 s. $3\frac{40}{100}$d.; if of iron or ſteel, 4 s. $8\frac{25}{100}$d.; and if of braſs, only $3\frac{75}{00}$d.

BODMIN, a borough-town of Cornwall, about twenty-ſix miles north-eaſt of Falmouth, in 5° 10′ W. long. and 50° 32′ N. lat. It ſends two members to parliament, and gives the title of viſcount to the earl of Radnor.

BODROCH, a town of Hungary, about an hundred miles ſouth-eaſt of Buda, and ſituated on the north-eaſt ſhore of the Danube, in 20° 15′ E. long. and 46° 15′ N. lat.

BODY, in phyſics, an extended ſolid ſubſtance, of itſelf utterly paſſive and inactive, indifferent either to motion or reſt. See MATTER, and MECHANICS.

Colour of BODIES. See OPTICS.

Deſcent of BODIES. See MECHANICS.

Diviſion of BODIES. See CHEMISTRY.

BODY, with regard to animals, is uſed in oppoſition to ſoul, in which ſenſe it makes the ſubject of anatomy.

BODY, among painters, as to bear a body, a term ſignifying that the colours are of ſuch a nature, as to be capable of being ground ſo fine, and mixing with the oil ſo intirely, as to ſeem only a very thick oil of the ſame colour.

BODY, in the manege. A horſe is chiefly ſaid to have a good body, when he is full in the flank. If the laſt of the ſhort ribs be at a conſiderable diſtance from the haunch bone, although ſuch horſes may, for a time, have pretty good bodies, yet, if they are much laboured, they will loſe them; and theſe are properly the horſes that have no flank. It is alſo a general rule, that a man ſhould not buy a light-bodied horſe, and one that is fiery, becauſe he will ſoon deſtroy himſelf.

BODY, in the art of war, a number of forces, horſe and foot, united and marching under one commander.

Main BODY *of an army*, the troops encamped in the centre between the two wings, and generally infantry: the other two bodies are the vanguard and the rear-guard; theſe being the three into which an army, ranged in form of battle, is divided.

BODY, in matters of literature, denotes much the ſame with ſyſtem, being a collection of every thing belonging to a particular ſcience or art, diſpoſed in proper order: thus, we ſay, a body of divinity, law, phyſic, *&c.*

BOEDROMIA, in Grecian antiquity, a feſtival celebrated yearly by the Athenians in the month Boedromion; for the ceremonies of which, ſee Potter's *Arch. Græc.* b. ii. c. 20.

BOEDROMION, in chronology, the third month of the Athenian year, anſwering to the latter part of our Auguſt and beginning of September.

BOERHAAVIA, in botany, a genus of the monandria monogynia claſs. It has no calix; the corolla conſiſts of one bell-ſhaped plaited petal; and there is but one naked ſeed. There are ſix ſpecies, all natives of the Indies.

BOESCHOT, a town of the Auſtrian Netherlands, ſituated in Brabant, about twelve miles north-eaſt of Malines, in 4° 40′ E. long. and 51° 5′ N. lat.

BOG properly ſignifies a quagmire, covered with graſs, but not ſolid enough to ſupport the weight of the body.

BOG, in geography, a river of Poland, which, running ſouth-eaſt through the province of Podolia and Buziac Tartary, falls into the Euxine ſea between Oczakow and the mouth of the Boriſthenes.

BOG, or BOG of GIGHT, a ſmall town of Scotland, near

near the mouth of the river Spey, situated in 2° 23′ W. long. and 57° 40′ N. lat.

BOGARMITÆ. See BOGOMILI.

BOGDOI, a great nation of Tartary in Asia. The Chinese call them eastern Tartars; and in the Mogul's country they are called Niuchi or Nuchi.

BOGHO, or BUEIL, a town in the county of Nice, in Piedmont, situated on the frontiers of France, about twenty-five miles north-west of Nice, in 6° 45′ E. long. and 44° 12′ N. lat.

BOGOMILI, or BOGARMITÆ, in church-history, a sect of heretics, which sprung up about the year 1179. They thought that but seven books of the scripture are to be received, that the use of churches, of the sacrament of the Lord's supper, and all prayer, except the Lord's prayer, ought to be abolished; that the baptism of Catholics is imperfect; that the persons of the Trinity are unequal, and that they oftentimes made themselves visible to those of their sect. They said, that devils dwelt in the churches, and that Satan had resided in the temple of Solomon from the destruction of Jerusalem to their own time.

BOGOTO, the capital of New Granada, in Terra Firma, situated in 74° W. long. and 4° N. lat.

BOHEA, in commerce, one of the best kinds of tea that come from China. There are three sorts of it: the first is bought at Canton for 80 tals *per* picē; the second for 45; and the third for 25. See TEA.

BOHEMIA, a kingdom subject to the house of Austria, bounded by Saxony on the north, by Poland and Hungary on the east, by Austria on the south, and by Bavaria and part of Saxony on the west. It lies between 12° and 17° E. long. and 48° and 52° N. lat.

BOHEMIAN *Bole*. See BOLE.

BOHOL, one of the Philippine islands, in Asia; E. long. 122°, N. lat. 10°.

BOJANO, a city of Molise, in the kingdom of Naples, about fifteen miles north of Benevento; E. long. 15° 20′, and N. lat. 41° 20′.

BOJARS denote Russian noblemen. See RUSSIA.

BOIGUACU, in zoology, a synonime of the boa constrictor. See BOA.

BOIL, or FURUNCLE, in surgery. See FURUNCLE.

BOILING, or EBULLITION, the agitation of a fluid body, arising from the application of fire. See CHEMISTRY.

BOIQUIRA, the American name for the rattle-snake.

BOIS *de soignies*, the forest of Soignies, in the Austrian Netherlands, and province of Brabant, about three miles south-east of Brussels.

BOISLEDUC, called by the Dutch Hertogenbosch, a large fortified town of Dutch Brabant, situated on the river Bommel, about twenty-three miles north-east of Breda: E. long. 5° 20′, and N. lat. 51° 45′.

BOKHARAH, BOCAR, or BOGHAR, a city of Tartary, in the country of the Usbecs, near Gihun and Bikunt.

BOLES are viscid earths, less coherent and more friable than clay, more readily uniting with water, and more freely subsiding from it. They are soft and unctuous to the touch, adhere to the tongue, and by degrees melt in the mouth, impressing a light sense of astringency. There are a great variety of these earths, the principal of which are the following.

1. Armenian bole, when pure, is of a bright red colour, with a tinge of yellow: It is one of the hardest and most compact of the bodies of this class, and not smooth and glossy like the others, but generally of a rough dusty surface. It does not effervesce with acids.

2. French bole is of a pale red colour, variegated with irregular specks of white and yellow. It is much softer than the Armenian, and slightly effervesces with acids.

3. Bole of Blois is yellow, remarkably lighter than the most of the other yellow earths, and effervesces strongly with acids.

4. Bohemian bole is of a yellow colour, with a cast of red, and generally of a flaky texture. It is not acted on by acids.

5. Lemnian earth is of a pale red colour, and slightly effervesces with acids.

6. Silesian bole is of a brownish yellow colour, and acids have no sensible effects upon it.

These and other earths, made into little masses, and stamped with certain impressions, are called *terræ sigillatæ*. These earths have been recommended as astringent, sudorific, and alexipharmic. But these, and many other virtues that have been ascribed to them, appear to have no foundation. They are still used in fluxes and complaints of the first passages.

BOLETUS, in botany, a genus of the cryptogamia fungi class. This mushroom is horizontal, spungy, and porous below. There are 14 species, of which seven are natives of Britain, *viz.* the suberosus, or cork boletus; the fomentarius, or spongy boletus; the versicolor, or striped boletus; the albus, or white boletus; the igniarius, or hard boletus, or touchwood; the bovinus, or brown boletus; and the luteus, or yellow boletus.

BOLINGBROKE, or BULLINGBROKE, a market-town of Lincolnshire, about twenty-five miles east of Lincoln; E. long. 15′, N. lat 53° 15′.

BOLISLAW, a town of Bohemia, about thirty miles north-east of Prague; E. long. 14° 40′, N. lat. 50° 25′.

BOLLARDS, large posts set into the ground, on each side of a dock. On docking or undocking ships, large blocks are lashed to them; and through these blocks are reeved the transporting hawsers to be brought to the capstons.

BOLLITO, a name by which the Italians call a sea-green colour in artificial crystal. To prepare this colour, you must have in the furnace a pot filled with forty pound of good crystal, first carefully skimmed, boiled, and purified, without any manganese: then you must have twelve ounces of the powder of small leaves of copper, thrice calcined, half an ounce of zaffer in powder; mix them together, and put them at four times into the pot, that they may the better mix with the glass, stirring them well each time of putting in the powder, for fear that it should swell too much and run over.

BOLOGNA, a city of Italy, fifty miles north of Florence. It is about five miles in circumference, and is remarkable for its magnificent churches and monafteries, as well as for its univerfity, which is one of the moft confiderable in Europe; E. long. 11° 40′, and N. lat. 44° 30′.

BOLOGNE. See BOULOGNE.

BOLONIAN *ftone*, is a fulphureous kind of ftone, about the bignefs of a walnut, found near Bologna; which, when duly prepared by calcination, makes a fpecies of phofphorus. See PHOSPHORUS.

BOLSENNA, a town of the pope's territories in Italy, about forty-five miles north of Rome, at the north end of a lake to which it gives name; E. long. 13° 45′, and N. lat. 42° 40′.

BOLSLAW, a town of Bohemia, fituated on the river Sizera, about thirty miles north-eaft of Prague; E. long. 14° 45′, and N. lat. 50° 24′.

BOLSTERS *of a faddle*, thofe parts of a great faddle which are raifed upon the bows, both before and behind, to hold the rider's thigh, and keep him in a right pofture.

BOLSWAERT, a town of Weft Friezland, in the United Provinces, about eighteen miles fouth-weft of Lewarden; E. long. 5° 20′, and N. lat. 53° 10′.

BOLT, among builders, an iron faftening fixed to doors and windows. They are generally diftinguifhed into three kinds, *viz.* plate, round, and fpring bolts.

Bolts in gunnery are of feveral forts; as, 1. Tranfum bolts, that go between the cheeks of a gun-carriage, to ftrengthen the tranfums. 2. Prife-bolts, the large knobs of iron on the cheeks of a carriage, which keep the hand-fpike from fliding when it is poizing up the breech of a piece. 3. Traverfe-bolts, the two fhort bolts that being put one in each end of a mortar-carriage, ferve to traverfe her. 4. Bracket-bolts, the bolts that go through the cheeks of a mortar, and by the help of quoins keep her fixed at the given elevation. And, 5. Bed-bolts, the four bolts that faften the brackets of a mortar to the bed.

Bolts in a fhip are iron pins, of which there are feveral forts, according to their different makes and ufes. Such are drive-bolts, ufed to drive out others. Ray-bolts, with jags or barbs on each fide, to keep them from flying out of their holes. Clench-bolts, which are clenched with rivetting hammers. Forelock-bolts, which have at the end a forelock of iron driven in, to keep them from ftarting back. Set-bolts, ufed for forcing the planks, and bringing them clofe together. Fend or fender-bolts, made with long and thick heads, and ftruck into the uttermoft bends of the fhip, to fave her fides from brufes. And ring-bolts, ufed for bringing to of the planks, and thofe parts whereto are faftened the breeches and tackles of the guns.

BOLT *of canvas*, in commerce, the quantity of twenty-eight ells.

BOLT-*rope*. See ROPE.

BOLTING, a term formerly ufed in our inns of court, for the private arguing of caufes. An ancient and two barrifters fat as judges; and three ftudents, bringing each a cafe, out of which the judges chofe one to be argued, the ftudents firft began to argue it, and after them the barrifters. It was inferior to mooting. See MOOT.

BOLTON, a market-town of Lancafhire, about twenty-feven miles north-eaft of Liverpool; W. long. 2° 20′, and N. lat. 53° 35′.

BOLUS, an extemporaneous form of a medicine, foft, coherent, a little thicker than honey, and the quantity of which is a little morfel or mouthful; for which reafon it is by fome called *buccella*.

Whatever is fit for internal ufe, either by itfelf, or when mixed with other fubftances, provided it is capable of the above mentioned confiftence, is a proper material for the compofition of a bolus. Such are foft fubftances more or lefs thick, as conferves, electuaries, robs, pulps, extracts; fyrups and liquid fubftances, as oils, fpirits, effences, elixirs, *&c.* The dofe of bolus may be extended from one dram to one dram and a half, or two drams.

BOLZAS, a fort of ticking which comes from the Eaft-Indies.

BOMAL, a town of Luxemburg, in the Auftrian Netherlands, fituated on the river Ourt, about 20 miles fouth of Liege; in 5° 30′ E. long. and 50° 20′ N. lat.

BOMB, in military affairs, a large fhell of caft iron, having a great vent to receive the fufee, which is made of wood. The fhell being filled with gunpowder, the fufee is driven into the vent or aperture, within an inch of the head, and faftened with a cement made of quick-lime, afhes, brick-duft, and fteel-filings, worked together in a glutinous water; or of four parts of pitch, two of colophony, one of turpentine, and one of wax. This tube is filled with a combuftible matter, made of two ounces of nitre, one of fulphur, and three of gunpowder duft, well rammed. To preferve the fufee, they pitch it over, but uncafe it when they put the bomb into the mortar, and cover it with gunpower duft; which having taken fire by the flafh of the powder in the chamber of the mortar, burns all the time the bomb is in the air; and the compofition in the fufee being fpent, it fires the powder in the bomb, which burfts with great force, blowing up whatever is about it. The great height the bomb goes in the air, and the force with which it falls, makes it go deep into the earth.

BOMB-CHEST, a kind of cheft ufually filled with bombs, fometimes only with gunpowder, placed under ground to tear it and blow it up in the air, with thofe who ftand on it. It was fet on fire by means of a fauciffe faftened at one end, but is now much difufed.

BOMB-BATTERY. See BATTERY.

BOMBARD, a piece of ordnance anciently in ufe, exceedingly fhort and thick, and with a very large mouth. There have been bombards which have thrown a ball of 300 pound weight. They made ufe of cranes to load them.

The bombard is by fame called *bafilifk*, and by the Dutch, *donderbufs*.

BOMBARDIER, a perfon employed about a mortar. His bufinefs is to drive the fufee, fix the fhell, load and fire the mortar.

BOM-

BOMBARDMENT, the havock committed in throwing bombs into a town or fortrefs.

BOMBARDO, a mufical inftrument of the wind kind, much the fame as the baffoon, and ufed as a bafs to the hautboy.

BOMBASINE, a name given to two forts of ftuffs, the one of filk, and the other croffed, of cotton.

Bombafine of filk pays duty on importation as other foreign filks. See SILK. That of cotton pays each piece, not exceeding 15 yards, if narrow, 1l. 3s. $1\frac{20}{100}$d. but if broad, 1l. 6s. $11\frac{40}{100}$d.

BOMBAST, in compofition, is a ferious endeavour, by ftrained defcription, to raife a low or familiar fubject beyond its rank; which inftead of being fublime, never fails to be ridiculous. The mind, in fome animating paffions, is indeed apt to magnify its objects beyond natural bounds. But fuch hyperbolical defcription has its limits, and, when carried beyond thefe, it degenerates into burlefque, as in the following example:

Sejanus. ——Great and high
The world knows only two, that's Rome and I.
My roof receives me not; 'tis air I tread,
And at each ftep I feel my advanc'd head
Knock out a ftar in heaven.

Sejan. Ben. Johnfon, act 5.

A writer who has no natural elevation of genius is extremely apt to deviate into bombaft: He ftrains above his genius, and the violent effort he makes carries him generally beyond the bounds of propriety.

BOMBAX, or COTTON-TREE, in botany, a genus of the monodelphia polyandria clafs. It has but one ftylus; the ftigma confifts of five lobes; the capfule has five cells; and the feeds are downy. There are three fpecies, *viz.* the pentandrum, the ceiba, and the heptaphyllum, all natives of the Indies. The cotton-tree grows generally above 60 feet high, and is fo thick that the Indians dig canoes which hold feveral men out of the whole wood. There are hollows in different parts of the trunk which contain large quantities of water, which is of great ufe to travellers in the hot climates where there is often a fcarcity of water. For the method of making cotton, fee COTTON.

BOMBAX, in zoology, a fynonime of a fpecies of conus. See CONUS.

It is fometimes ufed for filk or cotton. It is likewife applied by Linnæus to fignify fuch infects as have incumbent wings and feelers refembling a comb.

BOMBAY, an ifland on the weft coaft of the hither peninfula of India, fituated in 72° 20′ E. long. and 18° 30′ N. lat. It is about feven miles long, and twenty in circumference; and is the property of our Eaft-India company.

BOMB-KETCH, a fmall veffel built and ftrengthened with large beams for the ufe of mortars at fea.

BOMBUS, in medicine, a refounding and ringing noife in the ear.

BOMBYLIUS, in zoology, a genus of infects belonging to the order of diptera. The roftrum is long, briftly, and bivalved; the briftles being fixed between the horizontal valves. There are are five fpecies, *viz.* 1. The major, with black wings. 2. The medius, with a yellowifh body, white behind, and the wings fpotted with yellow. 3. The minor, with unfpotted wings. 4. The ater, has red wings, but a little blackifh at the bafe; and green feet. The above four are natives of Europe. 5. The capenfis, with the wings fpotted with black, an afh-coloured body, and white behind. It is a native of the Cape of Good Hope.

BOMENE, a port-town of Zeland, in the United Provinces, fituated on the northern fhore of the ifland of Schouen, oppofite to the ifland of Goree; in 4° E. long. and 51° 50′ N. lat.

BOMMEL, a town of Dutch Guelderland, fituated on the northern fhore of the river Waal, about four miles north-eaft of Nimeguen; in 5° 50′ E. long. and 52° N. lat.

BOMONICI, in Grecian antiquity, young men of Lacedæmon, who contended at the facrifices of Diana which of them was able to endure moft lafhes; being fcourged before the altar of this goddefs.

BON, in geography, a town of the electorate of Cologn, in Germany, fituated on the weftern fhore of the river Rhine, about 12 miles fouth of Cologn; in 7° E. long. and 50° 35′ N. lat. It is a fmall but well fortified town, and has a fine palace, which the elector of Cologn makes his ufual refidence.

BON is alfo the name of one of the Molucca iflands, lying weft of Coram.

BONA, in geography, a port-town of the kingdom of Algiers, in Africa, about 200 miles eaft of the city of Algiers; in 8° E. long. and 36° N. lat.

There is alfo a cape called Bona on the fame coaft to the eaftward, almoft oppofite to Sicily.

BONA-FIDES, in law: When a perfon performs any action, which he believes at the time to be juft and lawful, he is faid to have acted *bona fide.*

BONA *mobilia*, the fame with moveable goods or effects.

BONA *notabilia*, are fuch goods as a perfon dying has in another diocefe than that wherein he dies, amounting to the value of 5 l. at leaft; in which cafe the will of the deceafed muft be proved, or adminiftration granted in the court of the archbifhop of the province, unlefs by compofition, or cuftom, any diocefes are authorifed to do it, when rated at a greater fum.

BONA *patria*, an affize of country men, or good neighbours, where twelve or more are chofen out of the country to pafs upon an affize, being fworn judicially in the prefence of the party.

BONA, in geography, a cape of Africa, near Tunis, in the Mediterranean fea.

BONAIRE, an ifland near the coaft of Terra Firma, in South America, fituated in 67° W. long. and 12° 30′ N. lat. It is fubject to the Dutch, who traffic from thence with the Caracao-coaft.

BONAROTA, in botany, the trivial name of a fpecies of pæderota. See PÆDEROTA.

BONASIUS, in zoology, the trivial name of a fpecies of bos. See BOS.

BONAVENTURA, a fea-port town in Popayan in South America, upon the South fea.

BONAVISTA, one of the Cape Verd Iflands, fubject to Portugal; in 23° W. long. and 16° 30′. N. lat.

BOND, in Scots law, a formal writing by which a perſon binds himſelf to pay a certain ſum of money to another, or to perform a certain deed, under a penalty. Bonds reſpecting money are divided into heritable and moveable. See LAW, tit. *Heritable and moveable rights*.

BOND, in carpentry, a term among workmen; as, to make good bond, means that they ſhould faſten two or more pieces together, either by tenanting, mortiſing, or dovetailing, *&c.*

BONDAGE, properly ſignifies the ſame with ſlavery; but, in old law-books, is uſed for villenage. See VILLENAGE.

BOND-MAN, the ſame with villain. See VILLAIN.

BONDOUR, a city of Natolia in Aſia.

BONDUC, in botany, the trivial name of a ſpecies of guilandria. See GUILANDRIA.

BONE, in anatomy. See Part I.

BONE-ACE, an eaſy but licking game at cards, played thus: The dealer deals out two cards to the firſt hand, and turns up the third, and ſo on through all the players, who may be ſeven, eight, or as many as the cards will permit; he that has the higheſt card turned up to him, carries the bone, that is, one half of the ſtake, the other remaining to be played for: Again, if there be three kings, three queens, three tens, *&c.* turned up, the eldeſt hand wins the bone: But it is to be obſerved, that the ace of diamonds is bone-ace, and wins all other cards whatever. Thus much for the bone; and as for the other half of the ſtake, the neareſt to thirty-one wins it; and he that turns up or draws thirty-one, wins it immediately.

BON-ESPERANCE, the ſame with the Cape of Good-hope. See GOOD-HOPE.

BONGO, or BUNGO, the capital of one of the iſlands of Japan, to which it gives name; in 132° E. long. and 32° 30′ N. lat. It is a ſea-port town, ſituated on the eaſt ſide of the iſland, oppoſite to the iſland of Tonſa, from which it is ſeparated by a narrow channel.

BONIFACIO, in geography, a port-town of Corſica, ſituated at its ſouth end, in 9° 20′ E. long. and 41° 20′ N. lat. It is one of the beſt towns in the whole iſland, and gives name to the ſtreight between Corſica and Sardinia.

BONIS *non amovendis*, in law, is a writ directed to the ſheriffs of London, *&c.* charging them, that a perſon, againſt whom judgment is obtained, and proſecuting a writ of error, be not ſuffered to remove his goods until the error is determined.

BONNET, in a general ſenſe, denotes a cover for the head, in common uſe before the introduction of hats. See HAT.

Bonnets are ſtill uſed in many parts of Scotland.

BONNET, in fortification, a ſmall work, conſiſting of two faces, having only a parapet with two rows of paliſadoes, of about ten or twelve feet diſtance: It is generally raiſed before the ſaliant angle of the counterſcarp, and has a communication with the covered way, by a trench cut through the glacis, and paliſadoes on each ſide.

BONNET *à pretre*, or *Prieſt's* BONNET, in fortification, is an out-work, having at the head three ſaliant angles, and two inwards. It differs from the double tenaille only in this, that its ſides, inſtead of being parallel, are like the *queve d'aronde* or ſwallow's tail, that is, narrowing, or drawing cloſe at the gorge, and opening at the head.

BONNET, in the ſea-language, denotes an addition to a ſail: Thus they ſay, *lace on the bonnet*, or *ſhake off the bonnet*.

BONNEVILLE, a town of Savoy, ſituated on the north ſide of the river Arve, about twenty miles ſouth-eaſt of Geneva, in 6° 10′ E. long. and 46° 18′ N. lat.

BONNY, among miners, a bed of ore, differing only from a ſquat as being round, whereas the ſquat is flat. See SQUAT.

BONONIAN. See BOLONIAN.

BONOS-AYERES. See BUENOS-AYRES.

BONTIA, in botany, a genus of the didynamia angioſpermia claſs. The calix is divided into five pieces; the corolla is bilabiated, with the ſuperior labium emarginated, and the inferior conſiſts of three deep-cut ſegments; the berry, which is of the drupa kind, is oval, oblique at the apex, and contains but one plaited ſeed. The ſpecies are two, *viz.* the daphnoides and the germinata, both natives of the Indies.

BONZES, Indian prieſts, who, in order to diſtinguiſh themſelves from the laity, wear a chaplet round their necks, conſiſting of an hundred beads, and carry a ſtaff, at the end of which is a wooden bird. They live upon the alms of the people, and yet are very charitably diſpoſed, maintaining ſeveral orphans and widows out of their own collections. The Tonquineſe have a pagod, or temple, in each town, and every pagod has at leaſt two bonzes belonging to it; ſome have thirty or forty. The bonzes of China are the prieſts of the Fohiſts, or ſects of Fohi; and it is one of their eſtabliſhed tenets, that there are rewards allotted for the righteous, and puniſhments for the wicked in the other world; and that there are various manſions, in which the ſouls of men will reſide, according to their different degrees of merit. The bonzes of Pegu are generally gentlemen of the higheſt extraction.

BOOK, the general name of almoſt every literary compoſition; but, in a more limited ſenſe, is applied only to ſuch compoſitions as are large enough to make a volume. As to the origin of books or writing, thoſe of Moſes are undoubtedly the moſt ancient that are extant: But Moſes himſelf cites many books that behoved to be wrote before his time. See CHARACTER.

Of profane books, the oldeſt extant are Homer's poems, which were ſo even in the time of Sextus Empiricus; though we find mention in Greek writers of ſeventy others prior to Homer; as Hermes, Orpheus, Daphne, Horus, Linus, Muſæus, Palamedes, Zoroaſter, *&c.*; but of the greater part of theſe there is not the leaſt fragment remaining; and of others, the pieces which go under their names are generally held, by the learned, to be ſuppoſititious.

Several ſorts of materials were uſed formerly in making

making books: Plates of lead and copper, the barks of trees, bricks, ſtone, and wood, were the firſt materials employed to engrave ſuch things upon as men were willing to have tranſmitted to poſterity. Joſephus ſpeaks of two columns, the one of ſtone, the other of brick, on which the children of Seth wrote their inventions and aſtronomical diſcoveries: Porphyry makes mention of ſome pillars, preſerved in Crete, on which the ceremonies practiſed by the Corybantes in their ſacrifices were recorded. Heſiod's works were originally written upon tables of lead, and depoſited in the temple of the Muſes, in Bœotia: The ten commandments, delivered to Moſes, were written upon ſtone; and Solon's laws upon wooden planks. Tables of wood, box, and ivory, were common among the ancients: When of wood, they were frequently covered with wax, that people might write on them with more eaſe, or blot out what they had written. The leaves of the palm-tree were afterwards uſed inſtead of wooden planks, and the fineſt and thinneſt part of the bark of ſuch trees, as the lime, the aſh, the mapple, and the elm; from hence comes the word *liber*, which ſignifies the inner bark of the trees: and as theſe barks were rolled up, in order to be removed with greater eaſe, theſe rolls were called *volumen*, a volume; a name afterwards given to the like rolls of paper or parchment.

Thus we find books were firſt written on ſtones, witneſs the Decalogue given to Moſes: Then on the parts of plants, as leaves chiefly of the palm-tree; the rind and barks, eſpecially of the tilia, or phillyrea, and the Egyptian papyrus. By degrees wax, then leather, were introduced, eſpecially the ſkins of goats and ſheep, of which at length parchment was prepared: Then lead came into uſe; alſo linen, ſilk, horn, and laſtly paper itſelf.

The firſt books were in the form of blocks and tables; but as flexible matter came to be wrote on, they found it more convenient to make their books in the form of rolls: Theſe were compoſed of ſeveral ſheets, faſtened to each other, and rolled upon a ſtick, or *umbilicus*; the whole making a kind of column, or cylinder, which was to be managed by the umbilicus as a handle, it being reputed a crime to take hold of the roll itſelf: The outſide of the volume was called *frons*; the ends of the umbilicus, *cornua*, which were uſually carved, and adorned with ſilver, ivory, or even gold and precious ſtones: The title συλλαβος, was ſtruck on the outſide; the whole volume, when extended, might make a yard and a half wide, and fifty long. The form which obtains among us is the ſquare, compoſed of ſeparate leaves; which was alſo known, though little uſed, by the ancients.

To the form of books belongs alſo the internal œconomy, as the order and arrangements of points and letters into lines and pages, with margins and other appurtenants: This has undergone many varieties; at firſt the letters were only divided into lines, then into ſeparate words, which, by degrees, were noted with accents, and diſtributed, by points and ſtops, into periods, paragraphs, chapters, and other diviſions. In ſome countries, as among the orientals, the lines began from the right and ran leftward; in others, as the northern and weſtern nations, from left to right; others, as the Greeks, followed both directions, alternately going in the one, and returning in the other, called *bouſtrophedon*: In moſt countries, the lines run from one ſide to the other; in ſome, particularly the Chineſe, from top to bottom. See COMPOSITION.

BOOK-KEEPING.

BOOK-KEEPING is an art, teaching how to record and diſpoſe the accompts of buſineſs, ſo as the true ſtate of every part, and of the whole, may be eaſily and diſtinctly known.

Though the number and kinds of books uſed in this art be in ſome meaſure arbitrary, there are three which can never be diſpenſed with by thoſe whoſe trade is complex or extenſive, *viz.* the *Waſte-book*, *Journal*, and *Ledger*.

I. *Of the* WASTE-BOOK.

THE *Waſte-book* is a regiſter, containing an inventory of a merchant's effects and debts, with a record of all his tranſactions, narrated in a plain, ſimple ſtyle, and in the exact order of time as they ſucceed one another.

The Waſte-book opens with the *inventory*; which conſiſts of two parts: Firſt, the *effects*, that is, the money a merchant has by him, the goods he has on hand, his ſhare in ſhips, houſes, farms, *&c.* with the debts due to him; the ſecond part of the inventory is the debts due by him to others: The difference betwixt which and the effects, is what merchants call *neat ſtock*. When a man begins trade, the inventory muſt be gathered from a ſurvey of the particulars that make up his real eſtate; but muſt afterwards be collected from the balance of his old books, and carried to the new. This inventory is the firſt thing narrated in the Waſte-book, as being the ſource and ſpring whence all ſubſequent tranſactions flow.

After the inventory is fairly narrated in the Waſte-book, the tranſactions of trade come next to be jotted down;

down; which is a daily taſk, to be performed as they occur; and ſhould be done diſtinctly, that is, every thing ſhould be clearly and exactly expreſſed.

If no ſubſidiary books are kept, the Waſte-book ſhould contain a record of all the merchant's tranſactions and dealings in a way of trade; and that not only of ſuch as are properly and purely mercantile, but of every occurrence that affects his ſtock, ſo as to impair or increaſe it; ſuch as, private expences, ſervants fees, houſe-rents, money gained or loſt on wagers, legacies, and the like. By ſuch occurrences as theſe, a merchant as effectually becomes ſo much poorer or richer, as by the reſult of any branch of his trade. And the ends propoſed in book-keeping can never be gained, if ſuch things paſs unrecorded.

II. *Of the* Journal.

The *Journal* is the book wherein the tranſactions recorded in the Waſte-book are prepared to be carried to the Ledger, by having their proper debtors and creditors aſcertained and pointed out.

One great deſign of the Journal is, to prevent errors in the Ledger; a thing of the worſt conſequence in book-keeping; which yet, without the help of this book, would be almoſt inevitable. For, ſuppoſe a perſon ſhould attempt to form the *Debtors* and *Creditors* from the Waſte-book in his mind, and at the ſame time poſt them to the Ledger, he ſhall find his thoughts ſo much embarraſſed and over-charged, by attending at once to ſo many different things as occur here, that, were he an accomptant of very great experience, he could not well miſs of falling into frequent blunders. This makes it neceſſary to didvide the taſk, and do at twice what cannot be performed at once, without ſuch hazard of miſtakes; that is, firſt to write out the *Debtors* and *Creditors* in a ſeparate book by themſelves, and afterward transfer them to the Ledger. The work by this means being divided into parts, becomes more ſimple, and conſequently more eaſy, and ſo may be performed with greater certainty of its being right. Again, after the Ledger is filled up, the Journal facilitates the work required in reviſing and correcting it; for, firſt the *Waſte-book* and *Journal* are compared, and then the *Journal* and *Ledger*. Whereas, to reviſe and correct the Ledger immediately from the Waſte-book, would be a matter of no leſs difficulty than to form it without the help of a Journal. Laſtly, The Journal is deſigned as a fair record of a merchant's buſineſs: For neither of the other two books can ſerve this purpoſe; not the Ledger, by reaſon both of the order that obtains in it, and alſo on account of its brevity, being little more than a large Index. Nor can the Waſte-book anſwer this deſign; for being written up in the time of buſineſs, and commonly too by different hands, it can neither be fair and uniform, nor very accurate.

The Journal is a kind of middle book betwixt the other two; it looks back to the one, and forward to the other. With the Waſte-book it agrees in form, being ruled after the ſame manner. The order alſo and ſucceſſion of things is the ſame in both. The thing then that diſtinguiſheth the two books is the ſtyle; that of the one being natural, and that of the other artificial. In the Journal, perſons and things are charged *Debtors* to other perſons or things as *Creditors*; and in this it agrees with the Ledger, where the ſame ſtyle is uſed, but differs from it as to form and order: So that it agrees with the Waſte-book in thoſe very things wherein it differs from the Ledger; and on the other hand, it agrees with the latter in that very point wherein it differs from the former.

But an example of the Waſte-book turned into the Journal form, will give a clearer idea than can be conveyed by words.

WASTE-BOOK.

July 1ſt				*l.*	*s.*	*d.*
Bought 40 yards black cloth, at 14 *s.*				28	00	00
Bought of *James Sloan*, 100 yards ſhalloon at 10 *d.*	*l.*	*s.*	*d.*			
Whereof paid — —	2	00	00			
Reſt due at two months —	2	03	04	4	03	04
4th						
Sold *William Pope* 4 pipes Port-wine, at 27 *l.* 10 *s.*	*l.*	*s.*	*d.*			
Whereof received —	55	00	00			
Reſt due on demand —	55	00	00	110	00	00

JOURNAL.

July 1ſt				*l.*	*s.*	*d.*
Black Cloth Dr to *Caſh* 28 *l.* Paid for 40 yards, at 14 *s.* — —				28	00	00
Shalloon Dr to *Sundries* 4 3 4 (*l. s. d.*)	*l.*	*s.*	*d.*			
To *Caſh*, in part for 100 yards, at 10 *d.*	2	00	0			
To *J. Sloan*, for the reſt, at 2 months	2	03	4	4	03	04
4th						
Sundries Drs to *Port Wine* 110 *l.*	*l.*	*s.*	*d.*			
Caſh, in part, for 4 pipes, at 27 *l.* 10 *s.*	55	00	0			
Will. Pope, for the reſt on demand	55	00	0	110	00	00

Before proceeding to give rules for writing in the Journal, it will be neceſſary to take notice, that every caſe or example of the Waſte-book, when entered in the Journal, is called a *Journal poſt* or *entry*: Thus the examples above make up three diſtinct poſts. Again, a poſt is either ſimple or complex. A *ſimple poſt* is that which has

has but one Debtor and one Creditor, as the firſt of theſe above. A *complex poſt* is either when one Debtor is balanced by two or more Creditors, as in the ſecond poſt; or when two or more Debtors are balanced by one Creditor, as in the third poſt; or when ſeveral Debtors are balanced by ſeveral Creditors, and then the poſt is ſaid to be complex in both its terms. This being premiſed, the rules to be obſerved are theſe following.

I. In a ſimple poſt, the debtor is to be expreſsly mentioned, then the creditor, and, laſtly, the ſum, all in one line: After which follows the narrative, or reaſon of the entry, in one or more lines, as in the firſt of theſe three poſts above.

II. In a complex poſt, the ſeveral Debtors or Creditors are expreſſed in the firſt line, by Sundries, or Sundry Accompts, and the reſt of the line filled up as in the former rule. After which, the ſeveral Debtors or Creditors muſt be particularly mentioned, each in a line by themſelves, with their reſpective ſums ſubjoined to them; which are to be added up, and their total carried to the money-columns, as in the ſecond and third poſts.

The Journal, as deſcribed and exemplified above, is the form that was firſt in uſe among merchants; and is ſtill the moſt common: but ſome make their Journal juſt a fair copy of the Waſte-book, with the Debtors and Creditors written out on the margin, which is ruled large for that purpoſe. We ſhall here ſubjoin the three preceding poſts done after this way; which, to one who underſtands the common method, will be ſufficient inſtruction.

				July 1ſt.			
Dr *Black Cloth*,	*l.*	*s.*	*d.*	Bought 40 yards black cloth, at	*l.*	*s.*	*d.*
Cr *Caſh*, -	28	00	00	14*s.* — — —	28	00	00
Crs { *Caſh*, -	2	00	00	Bought of *James Sloan* 100 yards			
{ *J. Sloan*,	2	03	04	ſhalloon, at 10 *d.*			
				Whereof paid — — 2 00 00			
Dr *Shalloon*,	4	03	04	Reſt due at 2 mon. - 2 03 04			
					4	03	04
				4th.			
Drs { *Caſh*,	55	00	00	Sold *Will. Pope* 4 pipes Port wine, at			
{ *W. Pope*,	55	00	00	27*l.* 10*s.*			
				Whereof received — 55 00 00			
Cr *Port Wine*,	110	00	00	Reſt due on demand 55 00 00			
					110	00	00

Of the Terms DEBTOR *and* CREDITOR.

THE nature and uſe of the terms *Debtor* and *Creditor* will be obvious, from the conſiderations following.

I. Accompts in the Ledger conſiſt of two parts, which in their own nature are directly oppoſed to, and the reverſe of one another; which therefore are ſet fronting one another, on oppoſite ſides of the ſame folio. Thus, all the articles of money received go to the left ſide of the Caſh-accompt, and all the articles or ſums laid out are carried to the right. In like manner, the purchaſe of goods is poſted to the left ſide of the accompt of the ſaid goods, and the ſale, or diſpoſal of them, to the right, *&c.*

II. Tranſactions of trade, or caſes of the Waſte-book, are alſo made up of two parts, which belong to different accompts, and to oppoſite ſides of the Ledger: *e. g.* If goods are bought for ready money, the two parts are, the goods received, and the money delivered; the former of which goes to the left ſide of the accompt of ſaid goods, and the latter to the right ſide of the Caſh-accompt.

III. Theſe two different parts, in caſes of the Waſte-book, are not oppoſed to one another, as the two ſides of the Ledger-accompts are; but, on the contrary, have a mutual connection and dependence, the one being the ground, condition, or cauſe of the other. Thus, in the preceding example, when goods are bought for ready money, the receipt of the goods is the cauſe of parting with the money; and, on the other hand, the delivering of the money is the condition on which the goods are received.

From theſe three obſervations, it is plain, that, in order to poſt a caſe of the Waſte-book to the Ledger, the firſt thing the accomptant muſt do, is, to divide the caſe into its parts, and then to think with himſelf, to which accompt, and to what ſide, each of theſe parts is to be carried; and when the entry is actually made, the connection of the parts with one another muſt be expreſſed in each of the accompts to which they are tranſported. Now, ſince in ſpeaking and writing things muſt have names whereby they may be expreſſed and written, it is neceſſary that two words or terms be contrived, and appropriated to theſe two different parts, that have the ſame relation to one another as the parts themſelves have, which may at once characteriſe and diſtinguiſh the parts from one another, point out and aſcertain to what ſide of the Ledger each of them is to be carried, and withal expreſs their relation to, and dependence upon one another.

The Italians at firſt for this purpoſe pitched upon the terms

terms Debtor and Creditor, becaufe their common acceptation comes nearer to the thing here meant than any other they could think on. By means of thefe terms, the two parts, in any cafe of the Wafte-book, when pofted to the Journal, are denominated, the one the *Debtor*, and the other the *Creditor*, of that poft And when carried from thence to the Ledger, the Debtor, or Debtor part, is entered upon the left fide (hence called the *Debtor fide*) of its own account, where it is charged *Debtor* to the *Creditor part*. Again, the Creditor, or Creditor part, is pofted to the right fide, or Creditor-fide of its accompt, and made *Creditor* by the *Debtor part*. Hence Italian book-keeping is faid to be a method of keeping accompts by double entry, becaufe every fingle cafe of the Wafte-book requires at leaft two entries in the Ledger, *viz.* one for the Debtor, and another for the Creditor.

We fhall illuftrate what has been faid by two examples. *Firft*, Suppofe a merchant buys a pipe of wine for ready money, the two parts in this cafe are, the wine received, and the money delivered for it; which are characterifed by the terms *Debtor* and *Creditor* in the Journal poft thus: *Wine* Dr to *cafh*; where the meaning is, (though to exprefs it fo is needlefs), that as *Wine* is Dr to *Cafh*, fo *Cafh* is Cr by *Wine*. And accordingly when carried to the Ledger. the *Wine-accompt* is charged Dr to *Cafh*, and the *Cafh-accompt* is made Cr by *Wine*. Again, *2dly*. Admit the merchant fells this pipe of wine for prefent money, in this cafe the two parts are the fame as before; but when clothed with Debtor and Creditor, will ftand inverted thus: *Cafh* Dr to *Wine*. And accordingly, in the Ledger, the *Cafh-accompt* is charged Dr to *Wine*, and the *Wine-accompt* gets credit by *Cafh*. From all which it is evident, the terms *Debtor* and *Creditor* are nothing elfe but marks or characteriftics ftamped upon the different parts of tranfactions in the Journal, expreffing the relation of thefe parts to one another, and fhewing to which fide of their refpective accompts in the Ledger they are to be carried.

RULES *relating to* Debtor *and* Creditor.

I. A thing received upon truft, is Dr to the perfon of whom it is received.

II. The perfon to whom a thing is delivered upon truft, is Dr to the thing delivered.

III A thing received, is Dr to the thing given for it.

IV. In antecedent and fubfequent cafes, parts that are the reverfe of one another in the nature of the thing, are alfo oppofed in refpect of terms.

V In cafes where perfonal and real Drs or Crs are wanting, the defect muft be fupplied by fictitious ones.

VI. In complex cafes, the fundry Drs or Crs are to be made out from the preceding rules jointly taken.

We now proceed to the particular application of *Debtor* and *Creditor* in the feveral branches of trade, *viz.*

I. *Proper trade*, which a merchant carries on for himfelf.

II. *Factorage*, which he manages for another, called his *Employer*.

III. *Partnerfhip*, which is carried on by a truftee, in name of all the partners.

I. IN PROPER TRADE.

PROPER trade is either domeftic or foreign. *Proper domeftic trade*, is that which a merchant carries on by himfelf, without the help of a factor. *Proper foreign trade*, is the bufinefs that occurs to a merchant by employing a factor.

1ft, Debtor *and* Creditor *applied in proper* domeftic *trade.*

PROPER domeftic trade, comprehends the *inventory*, *buying*, *felling*, *bartering*, *receiving money*, and *paying money*. To each of thefe we fhall affign a diftinct problem; and, to prevent burdening the learner's memory, we fhall deliver the feveral cafes as compendioufly as poffible, fubjoining to each problem fuch notes as feem neceffary for clearing any thing that requires further illuftration.

N. B. As we refer from the cafes and notes of each problem, to the examples of the *Wafte-book* and *Journal*, by the dates, fo we have made ufe of letters and numbers, as references from them to the cafes and notes of the problems which the reader will eafily obferve.

Prob. I. A. Debtor *and* Creditor *applied to the inventory.*

The *inventory* confifts of two parts, and accordingly is journalized at twice, *viz.* 1 *Sundries* Drs to *Stock*. The feveral Drs are, *Cafh*, for the merchant's ready money; *Goods* on hand, for their refpective values; *Perfons*, for their debts due to him. 2 *Stock* Dr to *Sundries* The feveral Crs are, the perfons to whom the merchant owes. Compare the *Wafte-book* and *Journal*, *Jan.* 1

Note, *Stock* is a fictitious term ufed inftead of the merchant's name.

Prob. 2. B. Debtor *and* Creditor *applied in buying.*

In buying one fingle commodity there are feven diftinct cafes, (*viz.* three fimple, and four complex): in all which the goods bought and received are Dr; but the Cr varies according to the terms of purchafe.

Cafe 1. When goods are bought for ready money, the entry is, *Goods* bought Dr to *Cafh*. *Jan.* 6.

2. When goods are bought, and paid for by giving the feller a bill or note upon a third perfon, *Goods* bought Dr to the *Accepter*, *viz.* the faid third perfon

3. When goods are bought on time, *Goods* bought Dr to the *Seller*. *Jan.* 10 *Oct.* 21.

4. When goods are bought for part money, part bill.
Goods bought Dr to *Sundries*, *viz.*
To *Cafh*, for the fum paid,
To *Accepter*, for value of the bill.

5. When goods are bought for part money, part on time.
Goods bought Dr to *Sundries*, *viz.*
To *Cafh*, paid in part,
To *Seller*, for the reft. *Jan.* 15.

6. When goods are bought for part bill, part time.
Goods bought Dr to *Sundries*, *viz.*
To *Accepter*, for value of the bill,
To *Seller*, for the reft.

7. When goods are bought for part money, part bill, part time,
Goods bought Dr to *Sundries*, *viz.*
To *Cafh*, for the fum paid,

T

To *Accepter*, for value of the bill,

To *Seller*, for the rest. *Feb.* 2.

Note 1. When two or more kinds of goods are bought from one person at the same time, there will be two or more Drs, *viz.* the several kinds of goods bought, each for their value. And the same variety of cases will occur here as when one single commodity is bought; so that, if the sundry goods be bought for ready money, or on bill, or on time, the entry will be,

Sundries Drs,
- To *Cash*, if bought for ready money. *Feb.* 16.
- To *Accepter*, if on bill,
- To *Seller*, if on time.

But if the sundry goods are bought for part money, part bill, or for part money, part time, or for part bill, part time, &c. it is best to resolve the case into two entries, *viz.* First charge the *Goods* Dr to the *Seller*, for their full value, as if they had been bought on time; and then make the *Seller* Dr to *Cash*, or to the *Accepter*, or to both, (as the nature of the case is), for the part paid. Thus, suppose the goods are bought for part money, part bill, part time, the two entries will be,

1. *Sundries* Drs to the *Seller*, for the respective values of the goods.
2. *Seller*, Dr to *Sundries*, viz.
   To *Cash*, for the sum paid,
   To *Accepter*, for value of the hill.

Note 2. If you buy goods to be received some time afterward; and, in prospect of this, advance some part of the price to the seller: in this case, charge the *Seller* Dr to *Cash*, for the sum advanced; and when you receive the goods, make them Dr to the seller, for their full value. Or if immediately upon receiving them you clear with the seller, then make *Goods* received Dr to *Sundries*, viz. to the *Seller*, for the sum formerly advanced; and to *Cash*, for the sum now paid. In bargains of this nature, there is commonly a penalty agreed on to be paid by the seller in case of non-performance. Now, if in this case the seller happen to fail, you the buyer, upon receiving payment of the advanced money and penalty, enter *Cash* Dr to *Sundries*, viz. to the *Seller*, for the sum advanced, and now recovered, and to *Profit and Loss*, for the penalty: or, instead of using the general accompt, *Profit and Loss*, you may erect in the *Ledger* an accompt, under the title of *Refusal of bargains*, which is to be made *Debtor* for all the penalties of this nature you pay, and get *Credit* for all you receive. *May* 13. If you buy goods to be received afterwards, without advancing any part of the price; it is sufficient to take a note of them in a pocket-book; and when you receive them, they are booked as goods presently bought.

Prob. 3. C. Debtor *and* Creditor *applied in selling.*

Selling is just the reverse of buying, and has the same variety of cases, *viz.* seven; whereof three are simple, and four complex: in all which, the goods sold and delivered are Cr; but the Dr varies according to the conditions of sale.

Case 1. When goods are sold for ready money, the entry is, *Cash* Dr to *Goods* sold. *Feb.* 25.

2. When goods are sold on bill or note, *Accepter* Dr to *Goods* sold. *March* 17. See *Note* 7.

3. When goods are sold on time, *Buyer* Dr to *Goods* sold. *March* 1.

4. When goods are sold for part money, part bill,
   Sundries Drs to *Goods* sold, *viz.*
   Cash, for the sum received.
   Accepter, for value of the bill. *March* 22.

5. When goods are sold for part money, part on time,
   Sundries Drs to *Goods* sold, *viz.*
   Cash, received in part,
   Buyer, for the rest. *March* 4.

6. When goods are sold for part bill, part time,
   Sundries Drs to *Goods* sold, *viz.*
   Accepter, for value of the bill,
   Buyer, for the rest.

7. When goods are sold for part money, part bill, part time,
   Sundries Drs to *Goods* sold, *viz.*
   Cash, for the sum received,
   Accepter, for value of the bill,
   Buyer, for the rest.

Note 1. Thus the entries in buying and selling one single commodity are just the reverse of one another: and this also holds in buying and selling two or more kinds of goods; which we shall therefore pass, referring the learner to the cases of buying in the preceding problem.

Note 2. If you sell goods to be delivered, not presently, but some time afterward, and receive money *per* advance, charge *Cash* Dr to the *Buyer*, for the sum received; and when you deliver the goods, charge the *Buyer* Dr to said *Goods*, for their full value. But if, upon delivery of the goods, you immediately receive the remaining part of their price, enter *Sundries* (*viz.* the *Buyer*, for the sum received *per* advance, and *Cash*, for the sum now received) Drs to the *Goods* delivered. If you find you cannot perform the bargain, and be obliged to return the money advanced, and pay the penalty, make *Sundries* (*viz.* the *Buyer*, for the sum advanced, and *Profit and Loss*, or *Refusal of bargains*, for the penalty) Drs to *Cash* now paid.

Note 3. If you sell a ship, house, &c. enter *Cash*, or the *Buyer*, Dr to said *Ship* or *House*, for the price they are sold at.

Note 4. If you send goods to *A. B.* and leave it to his choice, whether to keep or return them, erect an account under the title of *Suspense-accompt*, and charge it Dr to the *goods* sent off. If the goods be returned, reverse the former entry. If he keep them, charge *A. B.* Dr to *Suspense-account*, for the value of the goods sent him. If he sends up the price, charge *Cash* Dr to *Suspense-accompt*. *May* 7. *June* 16.

Prob. 4. D. Debtor *and* Creditor *applied in bartering.*

Barter, or the exchanging of goods for goods, is nothing else but buying and selling blended together; the cases of which, if the goods received and delivered be of equal value, are these four.

Case 1. When one commodity is received for another delivered, enter *Wares* received Dr to *Wares* delivered. *April* 10.

2. When one commodity is received for two or more delivered, enter *Wares* received Dr to *Sundries*, *viz.* to the several *wares* delivered, for their respective values.

3. When two or more sorts of wares are received for one delivered, enter *Sundries* (*viz.* the several *wares* received, each for their value) Drs to *Wares* delivered. *April* 16.

4. When several wares are bartered with *A. B.* for several, make two entries, and that whether the wares received and delivered be of equal value or not.

1. *A. B.* Dr to *Sundries*, *viz.* to each sort delivered, for their respective values.
2. *Sundries* (*viz.* each sort received, for their respective values) Drs to *A. B.* *April* 30.

Note 1. Supposing the goods received and delivered are not in themselves of equal value, but that the deficiency is made up by money or bill, or the one merchant gives the other credit for the difference: upon this supposition there will be several other cases; such as, 1. *Wares* received, for part wares, part money. 2. For part wares, part bill. 3. Part wares, part time. 4. Part wares, part money, part time, &c. In all which cases, the *Wares* received are Drs to *Sundries*. The particular Crs in each case are as follows.

Case 1.
- To *Wares* delivered, for their value,
- To *Cash*, for the sum paid.

2.
- To *Wares* delivered, for their value,
- To *Accepter*, for the bill.

3.
- To *Wares* delivered, for their value,
- To *dealer*, for the rest.

4.
- To *Wares* delivered, for their value,
- To *Cash*, for the sum paid,
- To *Dealer*, for the rest.

Note 2. On the other hand, wares in barter may go off, or be delivered, 1. For part wares, part money. 2. For part wares, part bill. 3. Part wares, part time. 4. Part wares, part money, part time, &c. In all which cases, *Sundries* are Drs to the *Wares* delivered. The particular Drs in each case are the same with the Crs in the cases immediately preceding, as follows.

Case 1.
- *Wares* received, for their value,
- *Cash*, for the sum received. *April* 22.

2.
- *Wares* received, for their value,
- *Accepter*, for the bill.

3.
- *Wares* received, for their value,
- *Dealer*, for the rest.

4.
- *Wares* received, for their value,
- *Cash*, for the sum received,
- *Dealer*, for the rest.

Prob. 5. E. Debtor *and* Creditor *applied in receiving money.*

In all cases of this nature, *Cash* is Dr; but the Cr varies, according to the terms on which the money is received.

Case

Case 1. When you receive money for goods presently sold, the entry, as already mentioned in the first case of selling, is, *Cash* Dr to *Goods* sold, for their value. *Feb.* 25.

2. When you borrow, or take up money at interest, enter *Cash* Dr to the *Lender*, for the sum received, mentioning the rate of interest, and time of payment.

3. When you get money, whether as payment of a debt, or taken up at interest, and receive it, not from the debtor or lender, but upon his assignation from a third person, enter *Cash* Dr to the *Assigner*, not to *him* that pays it.

4. When you receive money, as payment of goods formerly sold, or in payment of an accepted bill or note, or any other debt, where neither discount nor interest is allowed, enter *Cash* Dr to the *Payer*, for the sum received, mentioning whether in full or in part. *Feb.* 5. *March* 23. *April* 6. *July* 30. *Aug.* 3. *Nov.* 12.

5. When you receive money, as payment of an accepted bill or note, or any other debt, (except for goods formerly sold), *per* advance, and upon that account allow discount, or abatement on any other consideration, enter

Sundries Drs to the *Payer*, *viz.*

Cash, for the sum received,

Profit and Loss, for the sum discounted or abated. *Nov.* 12

6. When, in receiving payment for goods formerly sold, you allow discount or abatement; if the accompt of said goods be closed in the *Ledger*, enter as in the last case: but if the said accompt be yet open, enter thus,

Sundries Drs to the *Buyer*, *viz.*

Cash, for the sum received,

Goods, for the sum discounted or abated. *April* 1.

7. When you receive money, as interest of a sum formerly lent, the principal being continued, enter *Cash* Dr to *Profit and Loss*, or to *Interest accompt*, for the sum received. *Sept.* 10.

8. When you receive both principal and interest, enter *Cash* Dr to *Sundries*, *viz.*

To the *Borrower*, for the principal,

To *Profit and Loss*, or to *Interest-accompt*, for the interest *Nov.* 8.

9. When you receive money as the premium for insuring another man's ship or goods at sea, enter *Cash* Dr to *Insurance accompt*, or to *Profit and Loss*.

10. When you receive money as the price of a ship, house, or estate, presently sold, or as the freight, or the rent of them, supposing the hiring out of the ship, or setting of the house, *&c.* not to be booked, enter *Cash* Dr to such a *Ship*, *House*, or *Estate*. *Sept.* 1.

11. But if the hiring out of the ship, house, or estate, was formerly booked, the entry for money received as freight or rent will be, *Cash* Dr to the *Freighter* or *Tenant*.

12. When you receive money, in legacy or compliment, or with an apprentice, or as gained on a wager, or by exchange of money, *&c.* for which nothing goes out, enter *Cash* Dr to *Profit and Loss*, or to *Stock*.

Note 5. It commonly happens that legacies are not paid presently: and in this case you must charge the executor *A B.* Dr to *Profit and Loss*, till you receive payment; and then discharge him by *Cash*, or the *Thing* received. *June* 3.

Prob. 6. F. Debtor *and* Creditor *applied in paying money.*

In all cases of this nature, *Cash* is Cr; but the Dr varies, according to the terms on which the money is delivered.

Case 1. When you pay money for goods presently bought, the entry (as already stated in the first case of buying) is, *Goods* bought Dr to *Cash*, for the sum paid. *Jan.* 6

2. When you lend or give out money at interest, enter the *Borrower* Dr to *Cash*, for the principal, mentioning the rate of interest, and time of payment. *March* 10. *August* 6.

3 When, by order of your creditor, you pay money to any person, enter the *Assigner* (not the *Assignee*) Dr to *Cash*, for the sum paid.

4. When you pay for goods formerly bought, or pay an accepted bill or note, or any other debt, where neither discount nor interest is allowed; enter the *Receiver* Dr to *Cash*, for the sum paid, mentioning whether in full or in part. *Jan* 15. *Jan.* 30. *March* 10. and 23. *May* 3. *June* 8. *June* 22. and 29.

5. When you pay an accepted bill or note, or any other debt, (except for goods formerly bought), *per* advance, and upon that account have discount allowed you, or abatement on any other consideration; enter

Receiver Dr to *Sundries*, *viz.*

To *Cash*, for the sum paid,

To *Profit and Loss*, for the sum discounted.

6. When, in paying for goods formerly bought, you have discount or abatement allowed; if the accompt of said goods in the *Ledger* be closed, enter as in the last case; but if the said accompt be yet open, enter thus,

Receiver Dr to *Sundries*, *viz.*

To *Cash*, for the sum paid,

To *Goods*, for the sum discounted or abated.

7. When you pay the interest of a sum formerly borrowed, the principal being continued in your own hand; enter *Profit and Loss*, or *Interest accompt*, Dr to *Cash*, for the sum paid.

8. When you pay both principal and interest, enter *Sundries* Drs to *Cash*, *viz.*

Lender, for the principal,

Profit and Loss, or *Interest-accompt*, for the interest.

9. When a ship or goods you have formerly insured happens to be lost, and thereupon you pay the value to the owners, enter *Insurance-accompt* Dr to *Cash*, for the sum paid.

10. When you pay for a ship, house, or estate, presently bought; or pay repairs, taxes, or other charges on them: enter *Ship*, *House*, *or Estate*, Dr to *Cash*, for the sum paid.

11. When you pay charges on goods, as freight, porterage, *&c.* enter *Goods* Dr to *Cash*, for the sum paid.

12. When you pay charges that relate to trade in general, such as warehouse rent, shop-rent, shop-keepers wages, postage of letters, *&c.* enter *Charges of merchandize* Dr to *Cash*. *July* 2. *July* 5.

13. When you pay your landlord rent for a dwelling-house, servants their wages, or make any disbursements for yourself or family; as all expences of this nature should be collected in a small book by themselves; so, when you bring them to the *Journal*, enter thus: *House-expences* Dr to *Cash*, for the total. *Nov.* 14. *Dec.* 30.

14,

14. When you pay upon losing a wager; or when you lose upon exchange, that is, put off a piece of coin for less than it cost you: or when you give away money in charity, or any other way not yet yet mentioned, for which nothing comes in; enter *Profit and Loss* Dr to *Cash* *Oct* 22.

Note 1. An assignation differs as to its nature and form from a bill or note; but the *Journal entry* is the same with respect to all of them. In an assignation there are three persons concerned: 1 He who gives the assignation, called the *Assignor*. 2 He on whom the assignation is given, or by whom it is payable, called the *Assigned*. 3. He to whom it is payable, called the *Assignee*. Here we shall propose two or three cases not yet taken notice of. 1. Suppose you pay a debt to *Samuel Needy*, by an assignment on *Peter Punctual*, the entry is, *Samuel Needy* Dr to *Peter Punctual*. 2. If *A. B.* give an assignment or bill on you to *M. S.* which you do not pay presently; in this case, charge *A. B.* Dr to *M. S.* 3. If *F. F.* give you an assignment or bill on *G. H.* which he does not pay presently, charge *G. H.* Dr to *F. F.* 4. If *J. H.* draw a bill on you to *G. L.* payable against a certain day, which you pay presently, upon having discount allowed you; in this case, make *J. H.* Dr to *Sundries*, *viz.* to *Cash*, for the sum paid, and to *Profit and Loss*, for the sum discounted.

Note 2. If you pay a debt with goods, instead of money, the goods delivered, and not *Cash*, will be Cr. As, 1. If you pay *A. B.* in goods, for goods formerly bought, or for a bill you have formerly accepted, and that whether in full or in part, enter *A. B.* Dr to the *Goods*, for their value. 2. If you pay him on the same account, part goods, part money, charge *A. B.* Dr to *Sundries*, *viz.* to *Goods*, for their value, and to *Cash*, for the rest. 3. If you give him goods above the debt, and he presently pay you back the balance in money, enter *Sundries*, *viz.* *A. B.* for the sum of the debt, and *Cash*, for the balance) Drs to *Goods*, for their full value. 4. If you give him goods above the debt, but do not presently receive the balance, enter simply *A. B.* Dr to *Goods* delivered, for their value. 5. If you pay interest of a bond, or sum borrowed, with goods, charge *Profit and Loss* Dr to the *Goods* delivered, &c.

Note 3. To prevent filling up your *Ledger* with accompts for every small dealer, you may erect a general accompt, under the title of *Debts general*, and charge it Dr for all such petty debts, mentioning in each entry the accompt to which, the person's name, and sum; and give it credit for all the payments, expressing also the accompts by which, with the persons names, and sums of money. To this credit-side also carry all such small debts you owe, and debit the accompt as you pay. Or, if you incline to be more distinct, erect two general accompts; one called *Debts receivable*, and the other *Debts payable*. Charge the former with all the petty debts due to you, and give it credit as you receive payment. Make the latter Cr for all the small debts due by you to others, and charge it Dr as you pay.

Note 4. In like manner, to save the labour of opening an accompt in the *Ledger* for every person you may have a bill upon, or who may have one on you, erect two general accompts; one, by the title of *Bills receivable*, and the other, *Bills payable*; and charge the former Dr for all the bills accepted, and payable to you, and give it credit as you receive payment. *March* 17 and 23. Make the latter Cr for all the bills you accept, and charge it Dr as you pay. *Sep.* 3. *Sep.* 10.

N. B. If the person have an accompt already opened in your *Ledger*, or if you have the prospect of dealing with him in other things for the future, you are not to use these general accompts.

Note 5. The entries mentioned in this and the preceding problem, with respect to wagers, suppose, that the wager is gained or lost, and the bets paid, before the wager is booked; which is indeed the best way, if the wager is very soon to be determined. But if you enter into a wager that cannot be soon decided, and thereupon consign the bets in a third person's hands; in this case, it is proper to erect an accompt under the title of *Wagers accompt*, and charge it Dr to *Cash*, for the sum consigned. If you gain the wager, and receive the bets, enter *Cash* Dr to *Wagers accompt*, for the sum received: if you lose, make *Profit and Loss* Dr to *Wagers accompt*, for the sum formerly consigned, and now lost. Sometimes the bets are consigned in one of the parties hands. Thus, in *April* 1734, two gentlemen in *London* entered into a wager concerning the reduction of *Dantzick* by the *Russians*; whereupon one of them consigned 100 guineas in the other's hands, upon condition that he should pay him three guineas a-day till the city should be taken or surrendered. In this case, if you receive the 100 guineas, enter *Cash* Dr to *Wagers accompt*; and when the wager is determined, make *Wagers accompt* Dr to *Cash*, for all you pay back. If you consign the 100 guineas, charge *Wagers accompt* Dr to *Cash*; and when the wager is decided, make *Cash* Dr to *Wagers accompt*, for all you receive back.

Note 6. These accompts, *viz.* *Refusal of bargains*, *Interest*, *Bottomry*, *Insurance*, *House expences*, are of the same nature with the general accompt *Profit and Loss*, being nothing else but particular branches of it; and the only design of keeping them distinct is, in order to know what is gained or lost on each of these several heads.

Note 7. When a ship or goods you have insured to another happens to be lost at sea, and thereupon you pay the value; after this the subject lost becomes your own: and if any of the wreck be recovered, enter the *Thing* recovered Dr to *Insurance-accompt*, for its value, and charge *Insurance-accompt* Dr to *Cash*, for what you expend in search of it.

Note 8. If you have frequent occasion to deal in outlandish money, or pieces not current, you may erect an accompt under the title of *Foreign coin*, or, particularly, *Spanish coin*, &c. and charge it Dr for what pieces you receive, and give it credit as you put them off. *March* 22. *March* 23.

Note 9. If any parcel of goods happen to be damaged or lost, or liquor to be ullaged, &c. charge *Profit and Loss* Dr to the *Accompt of the goods* or *liquor*, for the value of the damage, loss, or of the quantity ullaged, &c.

Note 10. We shall now conclude proper domestic trade, by reminding the learner, in posting any case to the *Journal*, carefully to consider, whether it be opposed in any of its parts to some preceding one; otherwise no rules, however particular, can be sufficient to direct his practice. For if the parts of a former and subsequent case be the reverse of one another, they must also be opposed in respect of terms, notwithstanding whatever particular rules may seem to say. Thus, suppose *A. B.* accept a bill payable to you, and thereupon you charge, not *A. B.* but the general accompt *Bills receivable* Dr; it is plain, that when you receive payment, you must enter *Cash* Dr, not to *A. B.* but to *Bills receivable*, notwithstanding what is said, *prob.* 5. *cas.* 4. See *March* 17. and 23. Again, admit you accept a bill payable to *A. B.* and thereupon credit, not *A. B.* but the general accompt *Bills payable*; it is evident, that when you pay, you must charge, not *A. B.* but *Bills payable*, Dr to *Cash*, notwithstanding *prob.* 6. *cas.* 4. See *Sept.* 3. and 10.

2dly, Debtor *and* Creditor *applied in proper* foreign *trade.*

Proper foreign trade comprehends, 1. *The shipping of goods to a factor.* 2. *Advices concerning them from the factor.* 3. *Returns made by the factor to you.*

Prob. 1. G. Debtor *and* Creditor *applied in shipping off goods to a factor.*

In all cases, *voyage to* ——— is Dr; but the Cr. varies, according as the goods shipped off are already entered in your books, or presently bought; and that again, either for ready money, or on time, &c.

Case 1. If you ship off goods which are already entered in your books, enter

Voyage Dr to *Sundries*, *viz.*
To the respective *Goods*, for their value,
To *Cash*, for custom, insurance, and all other charges.

2. If you buy a cargo for ready money, and ship it off immediately, without entering the purchase in your books, enter *Voyage* Dr to *Cash*, for prime cost, and all charges.

3. If you buy goods on time, and ship them off, without entering them in your books, enter

Voyage Dr to *Sundries*, *viz.*
To *Seller* or *Sellers*, for value of the goods,
To *Cash*, for charges at shipping.

4. If you ship off a cargo, made up partly of goods taken from your own warehouse, partly of goods bought, on time, enter

Voyage Dr to *Sundries*, *viz.*
To *Goods* your own, for their value,
To *Seller* or *Sellers*, for value of the goods bought,
To *Cash*, for all charges. *Jan.* 21.

Note 1. Several other cases may be supposed; such as, 1. When the *cargo* consists of goods, part your own, part bought for ready money. Or, 2 Part your own, the rest bought, part for ready money, part on time. *July* 22. Or, 3. All bought, part for ready money, part on time. Or, 4. Part your own, part bought, part immediately received in barter, or as payment of a debt. But the way of journalizing these and the like cases, may be easily gathered from what is already said; and therefore we shall leave them for the learner's exercise.

Note 2. If you do not pay charges at shipping immediately, you must credit the *Person* to whom it is due, and not *Cash*; or, if you please, erect a general accompt, under the title of *Debts payable*, or *Charges payable*, and charge *Voyage* Dr to it, and as you pay enter it Dr to *Cash*.

Note 3. As *Voyage* is to be debited for all charges, or whatever augments the cost; so it must be credited by whatever lessens the same, such as drawbacks on re-exported goods. *Sept.* 28.

Note 4. Instead of the title, *Voyage to*------, some use *Adventure to*-------, or *Adventure to*------ *per such a ship*; as, *Adventure to Barbadoes per the Neptune.*

Prob. 2. H. I. Debtor *and* Creditor *applied, upon advice from your factor*, A. B.

H § 1. *The cases of the first advice.*

In all cases of the first advice, *Voyage to* ——— is Cr but the Dr varies, according to the nature of the advice.

Case 1 If the first advice be, That *A. B.* has received your goods, but sold none of them, enter *A. B. my accompt of goods.* Dr to *Voyage*, for the sum the said voyage was formerly charged with.

2. If the first advice be That *A. B.* has received the goods, and sold them for ready money enter *A. B. my accompt current* Dr to *Voyage*, for the neat proceeds; that is, the sum due to you, after the factor's commission and all charges are deduced. *Sep.* 22.

3. If

3. If the firſt advice be, That the goods are received, and all ſold on time, enter *A B. my accompt on time* Dr to *Voyage*, for the neat proceeds

4. If the firſt advice be, That they are received, and all ſold, part for ready money, part on time, enter

Sundries Drs to *Voyage*, viz

A. B my accompt current, for the money in his hands,

A. B. my accompt on time, for the debts outſtanding.

5. If the firſt advice be, That the goods are not only received and ſold, but a cargo ſhipped in return, and now at ſea ; here there are three varieties. 1. If the value of the cargo inward, with charges paid by the factor, be equal to the neat proceeds, enter *Voyage* inward Dr to *Voyage* outward, for the neat proceeds. 2. If the factor overſh p the neat proceeds, enter *Voyage* inward Dr to *Sundries*, viz. to *Voyage* outward for the neat pro eeds, and to *Factor my accompt-current*. for the reſt. 3. If he underſhip the neat proceeds, enter *Sundries* (viz. *Voyage* inward, for its value, and *A. B. my accompt current*, for the reſt) Drs to *Voyage* outward. *June* 18

6. If the firſt advice be, whether from the factor or any body elſe, That the ſhip and cargo is loſt at ſea, there will be alſo three varieties. 1. If the goods loſt were not inſured, enter *Profit and Loſs* Dr to *Voyage*, for the whole value. 2. If the goods loſt were all inſured, charge the *Inſurer*, or *Caſh*, if you get preſent payment, Dr to *Voyage*. 3. If part of the goods only were inſured, make *Sundries* (viz. the *Inſurer*, or *Caſh*. for the value inſured. and *Profit and Loſs*, for the reſt) Drs to *Voyage*, for the whole loſs.

I. § 2. *The caſes of the ſecond advice.*

In journalizing a ſecond or third advice, reſpect muſt be had to the entry that was made upon the advice immediately preceeding ; for whatever was then Dr, muſt be now made Cr. And therefore, ſuppoſing the firſt or former advice was, That the factor had received the goods, but ſold none of them, the entry to be made upon a ſecond advice will be as in the caſes following.

Caſe 1. If the ſecond advice be, That the goods formerly received are now ſold, in whole or in part, for ready money, enter *A. B. my accompt-current* Dr to *ditto my accompt of goods*. for neat proceeds

2. If the ſecond advice be, That goods received formerly are now ſold in whole or in part. on time, enter *A B my accompt on time* Dr to *ditto my accompt of goods* for neat proceeds.

3 If the ſecond advice be, That goods formerly received are now old, part for ready money, part on time, enter

Sundries Drs to *A. B my accompt of goods*, viz

A. B my accompt current, for the money in his hands.

A B. my accompt on time, for the outſtanding debts.

But if the former advice had been, That the factor had ſold your goods on time, then. upon this ſuppoſition, the advice that comes next, whether ſecond or third, is journalized as follows.

Caſe 1. If the next advice be, That the factor has now received payment of the debts outſtanding, enter *A. B. my accompt current* Dr to *ditto my accompt on time*, for the ſum received by him.

2. If the next advice be, That he has indeed received payment of the debts, but was obliged to allow abatement, for inlack of goods, or for other reaſons, enter

Sundries Drs to *A. B. my accompt on time*. viz.

A. B. my accompt-current, for the ſum received by him,

Profit and Loſs, for the ſum abated.

Prob. 3. K. L. Debtor *and* Creditor *applied, when returns are made you by the factor.*

Returns are made in *goods* or *bills*.

K. § 1. *The caſes of returns in goods.*

Caſe 1. If the factor ſhip off, and conſign goods to yourſelf, adviſing you thereof by poſt, before the arrival of the ſhip, enter *Voyage from*——— Dr to *A. B. my accompt-current*, for coſt and charges of the cargo, as *per* factor's invoice.

2. If the factor ſhip off goods for yourſelf, of which you have no advice, or of which you book no advice, prior to the arrival of the ſhip, enter

Goods received Dr to *Sundries*, viz.

To *A B. my account-current*, for coſt and charges, as *per* invoice,

To *Caſh*, for new charges paid here.

3. If your factor *A. B.* at *Leghorn* ſhip off goods. not to yourſelf, but, by your order, to *C D.* your factor at *Liſbon*, and adviſe you thereof. by ſending you a copy of the invoice. enter *Voyage from Leghorn to Liſbon* Dr to *A. B. my accompt cnrrent*, for coſt and charges, as *per* invoice.

Note 1. The entries in this problem ſuppoſe that you have received the *accompt of ſales*, and debited the [illegible] neat proceeds; which naturally leads to give the accompt- urrent cre t here, and ſhows how the Dr part of a prior entry is reverted, or becomes Cr in a poſterior one.

Note 2. There are two or three caſes relative to thoſe mentioned, which we ſhall here take notice of. 1. When the ſhip and cargo mentioned in *caſe* 1. arrives, you enter *Goods* received Dr to *Sundries*, *viz.* to *voyage* hither, for what it was charged with, and to *Caſh*, for charges paid here. Or, if you pleaſe, firſt charge *Voyage* Dr to *Caſh*, for charges, ſee *July* 9. ; and then diſcharge the *Voyage* by the *Goods*, ſee *July* 10. Or, if you diſpoſe of all or any part of the cargo on the key, *viz.* before the voyage be diſcharged in your books, enter the *Buyer*, or *Caſh*, or *Thing* receved, Dr to the *Voyage*. See *July* 9. 2. If the ſaid ſhip and cargo ſhould happen to be loſt at ſea, then if the goods be not inſured, you enter *Profit and Loſs* Dr to *Voyage* inward, for what it was charged with But if the cargo be inſured, charge the *Inſurer*, or *Caſh* if you get preſent payment, Dr to *Voyage*, &c. 3. If a cargo conſigned to you happen to be loſt at ſea, which you have notice of before any entry is made in your Books; in this caſe, enter *Profit and Loſs*, the *Inſurer*, or *Caſh*, Dr to *A. B. my accompt current*, for the value loſt.

L. § 2. *The caſes of returns in bills.*

Caſe 1. If you draw upon your factor, and receive preſent money for the bill, enter *Caſh* Dr to *A. B. my accompt-current*, for value of the bill

2. If you draw upon your factor, and give the remitter a day for payment ; or if you owe the remitter, and give him the bill as payment; enter the *Remitter* Dr to *A. B my accompt-current*, for the value of the bill *July* 15.

3. If you draw upon your factor *A. B.* payable to your factor *C. D.* charge *C. D. my accompt-current* Dr to *A. B. my accompt-current*, for value of the bill.

4. If your factor remit you a bill, for which you receive preſent payment, enter *Caſh* Dr to *A. B. my accompt current*, for the value of the bill.

5. If your factor remit you a bill, payable at ſingle or double uſance, or any other time after date or ſight ; upon getting the bill accepted, enter *Bills receivable* Dr to *A. B. my accompt-current*, for value of the bill. *Sept.* 30.

6. If

6. If your factor *A. B* by your order, remit a bill to your factor *C. D.* charge *C. D. my accompt current* Dr to *A. B. my accompt-current*, for value of the bill.

2. In FACTORAGE.

Factorage comprehends three things: 1. The *receipt of the employer's goods.* 2. The *disposal of them.* 3. *Returns made for them.*

Prob. 1. M. Debtor *and* Creditor *applied upon the receipt of goods.*

When you turn factor, and have goods consigned to you by your employer: upon receiving the goods, enter *A. B. his accompt of goods* Dr to *Cash*, for freight, custom, or other charges you pay. *Aug.* 10.

Note 1. If there be but one kind of goods, name it; as, *A. B. his accompt of serges. A. B. his accompt of sugar*, &c.

Note 2. Instead of the title *A. B. his accompt of goods*, some use *A. B.'s sale* or *A. B.'s sale per such a ship*, as *A. B.'s sale per the Swallow.*

Note 3. In the following set of books, in regard no *Invoice-book* is supposed to be kept, the consigned goods are enumerated in the *Waste-book*; but in real business, or where an *Invoice-book* is kept, the common practice is, to copy them directly into it; and in the *Waste-book*, to mention only the money paid for freight, or other charges, without taking any notice of the names or quantity of the goods. Thus, the entry in the *Waste book, Aug.* 10. narrated in this manner, would stand as follows.

Paid freight, custom, wharfage, porterage, &c. of sundry goods *per* the *Griffin, John Temple* master, cosigned from *Herman Van Beck* of *Amsterdam*, for sale and returns, 14*l.* 12*s.* 6*d.*

Prob. 2. N. Debtor *and* Creditor *applied in disposing of your employer's goods.*

Case 1. When you sell all, or any part of your employer's goods, for ready money, enter *Cash* Dr to *A. B. his accompt of goods*, for the sum received. *Aug.* 17.

2. When you sell all, or any part of his goods, on time, charge the *Buyer* Dr to *A. B. his accompt of goods*, for the sum due. *Aug.* 23.

3. When you take all, or any part of his goods, to yourself at the current price; or when you put off his goods in barter, for others which you take to yourself; enter *Goods* received Dr to *A. B. his accompt of goods*, for their value.

4. When all your employer's goods are disposed of, balance his *accompt of goods*; that is, charge *A. B. his accompt of goods* Dr to *Sundries*, viz. to *Cash*, for any charges paid by you, not yet booked; or to the *person* or *persons* to whom they are due, if not yet paid; and to *Profit and Loss*, for your commission; and to *A. B. his accompt on time*, for the outstanding debts, if any; and to *A. B. his accompt-current*, for the employer's ready money in your hands. *Aug.* 23.

5. When you receive payment of the outstanding debts, enter as in *proper trade*, viz. *Cash* Dr to the *Buyers*; but if you be obliged to make abatement, for defect in weight or measure, or bad markets, &c. enter

Sundries Drs to the *Buyer*, viz.

Cash, for the sum received,

A. B. his accompt-current, for the sum abated.

6. When you receive payment of a debt on your employer's account, you must not only give the buyer or payer credit as directed above, but at the same time charge *A. B. his accompt on time* Dr to *ditto his accompt current*, for the whole sum of the debt, whether any abatement be allowed or not.

Note 1. If you allow abatement to the buyers, while the *accompt of goods* is yet open, you may charge *A. B. his accompt of goods* Dr to the *Buyers*, for the sum abated.

Note 2. When you pay the persons mentioned in *case* 4. who get credit at balancing the *accompt of goods*, such as packers, pressers, porters, coopers, dyers, brokers, &c. enter as in *proper trade*, viz. *Receiver* Dr to *Cash*; but if they allow abatement, this being your employer's profit, not your own, charge the *Receiver* Dr to *Sundries*, *viz.* to *Cash*, for the sum paid, and to *A. B. his accompt current*, for the sum abated. *Aug.* 31.

Prob. 3. O. P. Debtor *and* Creditor *applied when you make returns to your employer.*

Returns are made either in *goods* or *bills*.

O. § 1. *The cases of returns in goods.*

Case 1. When you buy up goods for ready money, and ship them off for your employer, enter

A. B. his accompt current Dr to *Sundries*, viz.

To *Cash*, for prime cost, and charges paid,

To *Profit and Loss*, for your commission.

2. When you buy goods on time, and ship them off for your employer, enter

A. B. his accompt-current Dr to *Sundries*, viz.

To *Sellers*, for prime cost of the goods,

To *Cash*, for charges, as custom, insurance, &c.

To *Profit and Loss*, for your commission.

3. When you take goods of your own, and valuing them at the current price, ship them off for your employer, enter

A. B his accompt-current Dr to *Sundries*, viz.

To *Goods* sent off, for their value,

To *Cash*, for charges at shipping,

To *Profit and Loss*, for your commission.

Note 1. There may be several other cases; as, 1. When the goods shipped off are bought, part for ready money, and part on time, *May* 18. 2. When part of them are bought for ready money, part of them your own. *August* 30. 3. When part of them are bought on time, the rest being your own. 4. When part of them are bought for ready money, part on time, part of them your own. All which being compounds of the cases mentioned, can prove no difficulty to the learner.

Note 2. The *Journal Entry* is the same, whether the goods shipped off be in return for goods sold by you, or in answer to your employer's commission, when you have none of its effects or money in your hand. *May* 18. The entry is also the same, whether the goods shipped off be consigned to himself, or by his order to his factor, or any other person.

Note 3. If the charges on shipping are not presently paid, the Cr will not be *Cash*, but the *persons* to whom they are due. *May* 18. *August* 30. Or, if you please, the general accompt, *Debts payable*, or *Charges payable*. And when you pay, enter the *Receiver*, or *Charges payable*, Dr to *Cash*. *May* 22. But if abatement be allowed you, this being your employer's advantage, not your own, enter the *Receiver*, or *Charges payable*, Dr to *Sundries*, *viz.* to *Cash*, for the sum paid, and to *A. B. his accompt-current*, for the sum abated. *Aug.* 31.

Note 4. In like manner, when you pay for the goods mentioned *case* 2. enter as in *proper trade*, *viz.* the *Sellers* Drs to *Cash*; but if abatement be allowed you, you must charge the *Sellers* Drs to *Sundries*, *viz.* to *Cash*, for the sum paid, and to *A. B. his accompt-current*, for the sum abated.

P. § 2. *The cases of returns in bills.*

Case 1. When your employer draws a bill on you, which you accept and pay on sight, enter *A. B. his accompt-current* Dr to *Cash*, for value of the bill.

2. When your employer draws a bill on you, payable at 1 or 2 usance, enter *A. B. his accompt-current* Dr to *Bills payable*, for value of the bill. *Sept.* 3.

3. When you draw upon your employer, enter *Cash*, if you receive present money for the bill; or, if not, the *Remitter* Dr to *A. B. his accompt-current*, for value of the bill. *May* 31.

4. When you remit a bill to your employer, for which you pay ready money, enter *A. B. his accompt-current* Dr to *Cash*, for value of the bill. *Sept.* 8.

5. When you remit a bill to your employer, which you either procure on time, or receive in payment of a debt due to you by the drawer, enter *A. B. his accompt-current* Dr to the *Drawer*, for value of the bill.

6. When

6. When your employer remits a bill to you, enter *Cash*, if you receive present payment; or, if not, *Bills receivable*, Dr to *A. B. his accompt-current*, for value of the bill.

Note 1. When you pay the bill mentioned in *case* 2. enter *Bills payable* Dr to *Cash*. *Sept*. 10.

Note 2 Charge *A. B. his accompt current* Dr to *Cash*, for all charges you pay in making returns, such as postage.

Note 3. Having now shewn how to keep *factory-accompts* in your own books, along with your other business, it will not be improper to observe, that these accompts may also be kept, by help of the *Sales book*, without bringing any thing to your *Ledger*, or other books, except the *accompt current*, thus: Turn the *Sales-book* into a folio-form; and when you receive the consigned goods, enter them on the Dr side, mentioning their quantity, mark, and number, with the charges you pay; to which side also carry all after charges, abatements made to buyers, and your own commission On the Cr side, enter the *sales*, mentioning the names of the buyers on time; and, as they pay, mark the article as paid on the margin; or, which will do just as well, never draw out the sums to the money columns, till you receive payment. In your *Ledger*, give *A. B. his accompt current* credit for all the money you receive for his goods, and make the same accompt Dr for all the charges paid by you, abatements made to buyers, your own commission, and returns made to your employer. But though this method may now and then be used with respect to small consignments; yet the conducting of large concerns in factory requires the use of all the five books mentioned at the beginning of this chapter.

Note 4. When you cannot dispose of your employer's goods to advantage, and thereupon by his order ship them off to a factor of your own, in expectation of a better market, the regular method in this case is, 1. When you ship off the goods, enter *Voyage to*——for account of your *Employer*, Dr to *Cash*, for charges paid at shipping 2. When you have advice from your factor, that he has received them, enter your *Employer his accompt of goods* in the hands of *factor*, or rather your *Employer his accompt of goods* at such a place, Dr to *Voyage* thither, for charges of the said voyage. 3. When you have advice that he has sold them, *e. g.* for ready money, enter your *Employer his accompt current at*—— Dr to *ditto his accompt of goods at*——, for neat proceeds. The entry in any other case will be obvious to one who understands *proper trade* and *factorage*, as explained above But though this be the regular method, yet in real practice, the best way, in our opinion, is, when you ship the goods, to charge the employer's *accompt of goods* (as they stand in your *Ledger*) Dr to *Cash*, for charges at shipping. making no more entries, till you receive the *Accompt of sales*, and then charge *A. B. his accompt of goods*, for the neat proceeds; and discharge *A. B. his accompt current* at ——, as returns are made to you by your factor.

3. In PARTNERSHIP.

Partnership is that branch of trade which is managed and carried on by a trustee, in the name, and for the account of the partners; that is, when a joint stock, made up by two or more merchants, is deposited in the hands of one person, to be employed by him in a way of commerce, according to instructions.

Merchants, upon entering into *partnership*, generally chuse one of their own number, to whom they commit the management of their company-concerns; who, on account of his being partner, as well as manager or doer for the company, is called *partner-trustee*; and shares of gains and losses that happen, according to his share of the stock; and must allow his proportion of all charges, even of his own commission, since, in quality of trustee, he serves himself as partner equally with the rest.

The accompts of the company's affairs may be kept by the trustee in his own books, along with the accompts of his own private business; or they may be kept in separate books allotted for that purpose. The former is common practice, in matters of small concern, or short adventures; the latter is used by fixed companies, whose trade is considerable, or who have the prospect of dealing long that way.

Hence it is obvious, that each partner will have occasion to keep an accompt in his own books, of every thing he gives in and receives from the company, and also of what he owes to the company, or they to him: and, on the other hand, it will be the business of the trustee, not only to keep clear accompts with the persons he deals with, in buying up and disposing of goods for the company; but he must also keep distinct accompts, with respect to the partners, shewing what share each of them gives in, and what part of neat proceeds is due to them, and likewise what every one of them owes to the company, or the company to them. These things premised,

1. We shall shew how a partner keeps the accompts which he has occasion for.

2. The way how a trustee keeps the accompts of the company's affairs in his own books.

3. The manner of keeping company-accompts in books, apart, that contain nothing else.

1. *How a partner keeps the accompts he has occasion for.*

The *Ledger-accompts* described.

A merchant concerned as partner in a company, must keep the two *Ledger-accompts* following; in which observe, that *A. B.* represents the trustee's name.

1. *A. B. my accompt in company*. This *accompt* is Dr for your inputs, and proportion of all charges, and Cr for your share of neat proceeds.

2. *A. B. my accompt proper*. This is a personal accompt, being charged and discharged exactly as such, for the mutual debts and payments betwixt you and the trustee

Note 1. *A. B. my accompt in company*, is a general title, that may represent one or more kinds of goods; and that whether in the trustee's custody, or by him sent to sea. But different authors title this accompt differently. Some chuse to express it thus: *Goods in the hands of A. B.*; or particularly, *Broad cloth in the hands of A. B.* If it be a sea-adventure, you may use the title, *A. B. my account of Voyage to* ———. If the company be

be fixed, the title may be taken from the commodity they deal in, as *Accompt in Wine-company*, *accompt in Tobacco company*, &c.; or from the place they trade to, as *Accompt in East-India company*, &c.

Note 2. Instead of *A. B. my accompt proper*, some write *A B. my accompt-current*; some too write *A B. his accompt current*; and others title this accompt simply by the trustee's name. But though the titles of accompts are in some sort arbitrary, or as the merchant pleases, yet it is suitable or congruous, that they carry in them some badge of distinction, shewing to what class of accompts they belong.

We now proceed to a particular application of Dr and Cr in the cases that most commonly occur on this head, which shall be confined to the two problems following.

Prob. 1. Q. Debtor and Creditor *applied, when you give in your share of stock to the trustee.*

Case 1. If you give in just your own part; and that either, 1. In money, or in goods presently bought for ready money; or, 2. In goods presently bought on time; or, 3. In goods already entered in your books, enter *A. B. my accompt in company* Dr

To *Cash*, if you give in money, or pay for goods, *Oct.* 4.
To *Seller*, if you buy goods on time,
To *Goods proper*, if the goods were formerly your own.

2. If you find both your own part and the trustee's, enter *Sundries* (viz. *A. B. my accompt in company*, for your own part, and *A. B. my accompt proper*, for his part) Drs.

To *Cash*, if you give in money, or pay for goods,
To *Seller*, if you buy the goods on time,
To *Goods proper*, if you give in goods formerly your own, *Oct.* 9.

3. If the trustee provide both your part and his own, enter *A. B. my accompt in company* Dr to *ditto my accompt proper*. And when you pay him, charge *A. B. my accompt proper* Dr to *Cash*. But if he demand interest, make *Sundries* (viz. *A. B. my accompt proper*, for the debt, and *Profit and Loss*, for the interest) Drs to *Cash*.

Note 1. There may be several other varieties in *case* 1. besides those mentioned; as, 1. When you give in part money, part goods presently bought on time 2. When you give part in money, part goods of your own. 3. When you give in goods, part bought on time, part your own. 4 When you give in part money, part goods bought on time, part goods of your own. In all which cases, enter *A. B. my accompt in company* Dr to *Sundries*, as follows.

Variety 1 [To *Cash*. for the sum given in,
To *Seller*, for value of the goods bought.

2. [To *Cash*, for the sum given in,
To *Goods proper*, for their value.

3. [To *Seller*, for value of the goods bought,
To *Goods proper*. for their value.

4. [To *Cash*, for the sum given in.
To *Seller*, for value of the goods bought,
To *Goods proper*, for their value.

Note 2. The like varieties may be supposed in *case* 2. In journalizing of which, the best method is, first to enter *A. B. my accompt in company* Dr to *Sundries*, as in the former *note*, for the whole value of the money, and goods given in; and then, in another entry, charge *A. B. my accompt proper* Dr to *ditto my accompt in company*, for the trustee's part. And when the trustee pays you for his part, enter *Cash* Dr to *A. B. my accompt proper*, *Oct.* 11. But if he pay you also interest, make *Cash* Dr to *Sundries*, *viz.* to *A. B. my accompt proper*, for the debt, and to *Profit and Loss*, for the interest.

Prob. 2. R. Debtor *and* Creditor *applied, when goods in company are disposed of, and you receive all or part of your share of neat proceeds.*

Case 1. If you have advice of sales, and at the same time receive your share of neat proceeds; which may be either in money, bills, or goods; enter *Cash*, *Bills receivable*, or *Goods received*, Dr to *A. B. my accompt in company*, for value received, *Oct.* 9. and 20.

2. If you have only advice of sales on time, without receiving any thing, enter *A. B. my accompt proper* Dr to *ditto my accompt in company*, for your share of neat proceeds due to you; and when you receive payment, charge *Cash*, *Bills receivable*, or *Goods*, Dr to *A. B. my accompt proper*, for value received. But if the trustees had been obliged to allow abatement to the buyers, or had any of the debts outstanding proved bad, then, in this case if the *accompt in company* be yet open, enter *Sundries* (*viz Cash Bills receivable. &c.* for the sum received, and, *A. B my accompt in company*, for your share of the sum abated or lost) Drs to *A. B. my accompt proper*. If the *accompt in company* be balanced, charge *Profit and Loss* Dr for your share of the abatement, or of the loss.

3 If the goods are sold, part for ready money, part on time, and thereupon you receive your share of money received, enter *Sundries* (*viz Cash*, for the sum you receive, and *A. B. my accompt proper*, for your share of sales on time) Drs to *A. B. my accompt in company*.

4. If part of the goods only are sold, you may put off the booking of it till further advice; unless it be for ready money, of which you immediately receive your share: in which case, enter *Cash* Dr to *A. B. my accompt in company*, for the sum you receive.

5. If you withdraw your share of stock, or any part of it, enter *Cash*, or *Goods withdrawn*, Dr to *A. B. my accompt in company*, for the sum or value withdrawn.

6. If after the goods are disposed of, you take up only your share of neat gain, continuing your share of stock as a fund for a new adventure, charge *Cash* Dr to *Profit and Loss*, for the sum received, and let the *accompt in company* stand as it is.

N. B. This is the ordinary case in fixed companies.

Note 1. There may be other varieties in *Cases* 1. & 2. besides those mentioned; *viz.* 1. You may receive, as your share of neat proceeds, part money, part bill; and then *Sundries* are Drs, *viz.* *Cash*, and *Bills receivable*. *Oct.* 9. 2. You may receive part money, part goods; and then the Drs are, *Cash*, and *Goods received*. *Oct.* 20. 3. You may receive part bill, part goods; and then the Drs are, *Bills receivable*, and *Goods received*. 4. You may receive part money, part bill, part goods; and then there will be three Drs, *viz.* *Cash*, *Bills receivable*, and *Goods received*.

N. B. If the person on whom you get the bill have an accompt in your *Ledger*, make him Dr, and not *Bills receivable*.

2. *How a trustee keeps the company's acoompts in his own books.*

The *Ledger acompts* described.

A Trustee who keeps the company's accompts in his own books, has occasion for the three *Ledger-accompts* following, in which *A. B.* represent your partner's name.

1. *Goods in company with A. B.* or *Sales in company with A. B.* or particularly *Sugar in company with A. B.* This accompt is debited for the value of the goods brought into company, for all charges, and your commission: it is credited as you dispose of the goods, in the same manner as if the goods were your own.

2. *A. B. his accompt in company*. This is credited for your partner's inputs, his share of charges, and proportion of neat gain at close: it is debited for his share of neat

neat proceeds, and his proportion of loſs, if any, when the company accompts are finiſhed.

3. *A. B his accompt proper.* This is a perſonal accompt, which is debited and credited for the mutual debts contracted and payments made betwixt you and partners.

Note 1. If the company deal in foreign trade, you who manage as truſtee will have occaſion for other accompts, *viz. Voyage in company, Factor our accompt current, &c.* all which are uſed the ſame way as their parallels in *proper foreign trade.*

Note 2. As you muſt keep an *accompt in company*, and an *accompt proper*, for each partner; ſo, if theſe be compared with the accompts of the like name kept by the partners, they will be found exactly the reverſe of one another; that is, the Dr ſide of the accompts kept by you will be the ſame with the Cr ſide of thoſe kept by partners; and on the other hand, the Cr ſide of the former will be exactly the Dr ſide of the latter.

Note 3. Inſtead of the title *A. B his accompt proper*, a great many uſe *A. B. his accompt current*. And it muſt be owned the merchant is at liberty to do in this as he inclines; it comes to the ſame thing in the iſſue, only the one title is more diſtinctive than the other.

Prob. 1. S. Dr *and* Cr *applied, when goods are brought into company.*

Caſe 1. If the goods are bought, (which is either from you the truſtee, or from a partner, or from a neutral perſon,) enter twice; *viz. 1ſt, Goods in company* Dr

To *Goods proper*, if bought of yourſelf,
To *Partner's accompt proper*, if of a partner,
To *Caſh*, or *Seller*, if of a neutral perſon
} for value of the goods bought.

2*dly*, Charge each partner *his accompt-proper* Dr to *ditto his accompt in company*, for his part of the purchaſe *Oct.* 26. *Nov* 22

Note. When you pay a neutral perſon for goods bought on time, charge the ſaid *Perſon* Dr to *Caſh*; and there is no ſecond entry. *Oct.* 27. *Nov.* 25. But if he allow you diſcount or abatement, enter twice; namely, 1. *Seller* Dr to *Sundries*, viz. to *Caſh*, for the ſum paid, and to *Goods in company*, for the ſum diſcounted or abated. 2. Each partner's *accompt in company* Dr to *ditto his accompt-proper*, for his ſhare of the ſum diſcounted or abated.

Caſe 2. If each partner bring in juſt his own part of goods to company, enter once; *viz.*

Goods in company Dr to *Sundries, viz.*

To *Goods proper*, for value of your ſhare,

To each *Partner his accompts in company*, for value of their ſhares.

Note 1. This is ſhorter than to enter as if the goods were bought, though that way would alſo be right, and prove the ſame in effect.

Note 2. Enter alſo as above, if the partners give in each his own part in money, with which you buy goods; or, which is the ſame thing, if upon buying of the goods each partner inſtantly pay down his part of the price, only *Caſh*, and not *Goods proper*, will be Cr for your own part. *Oct* 22.

Note 3. But if you inſtantly book the money received from the partners, enter *Caſh* Dr to *Sundries*, viz. to each partner's *accompt in company*. And when you buy the goods, charge *Goods in company* Dr to *Caſh*, for their value; and there is no ſecond entry.

Caſe 3. If you or partner pay charges on goods brought into company, as carriage, inſurance, *&c.* this augments the coſt, and muſt be entered as the coſt, namely, *1ſt, Goods in company* Dr

To *Caſh*, if paid by you. *Oct* 25. *Nov* 1.

To *Partner, his accompt proper*, if paid by him.

2*dly* Each partner *his accompt proper* Dr to *ditto his accompt in company*, for his ſhare of the ſaid charges.

Prob. 2. T. Debtor *and* Creditor *applied, when goods in company are diſpoſed of.*

Caſe 1. If goods in company are ſold, (which is either to you the truſtee, or to a partner, or to a neutral perſon,) a double entry is neceſſary; *viz. 1ſt,*

Goods proper, if ſold to yourſelf,
Partner's accompt-proper, if to him on time,
Caſh, or *Buyer*, if to a neutral perſon,
} Dr

To *Goods in company*, for their value in the ſale.

2*dly*, Each partner *his accompt in company* Dr to *ditto his accompt proper*, for his ſhare of the ſale. *Oct.* 29. *Nov.* 1. and 30. *Dec.* 2. 18. and 28.

Note 1. The entries are the ſame when you receive freight for a ſhip in company. *Oct.* 25. *Dec.* 27.

Note 2. When you receive payment for goods in company formerly ſold to a neutral perſon, charge *Caſh* Dr to the *Buyer*; and there is no ſecond entry. *Nov.* 1. *Dec.* 13. But if you allow diſcount or abatement to the buyers, a double entry is neceſſary: namely, *1ſt. Sundries* (*viz. Caſh*, for the ſum received, and *Goods in company*, for the ſum diſcounted or abated) Drs to the *Buyer*; 2*dly*, Each partner *his accompt proper* Dr to *ditto his accompt in company*, for his part of the diſcount or abatement. *Dec.* 20.

Note 3. If goods in company be damaged, deſtroyed, or loſt, enter *Sundries* (*viz.* each partner *his accompt proper*, for their reſpective ſhares of the damage or loſs, and *Profit and Loſs*, for your own ſhare) Drs to *Goods in company.*

Caſe 2. If goods in company are diſpoſed of in barter, for other goods of the ſame value brought into it, charge *Goods in company* received Dr to *Goods in company* delivered; and there is no ſecond entry. *Dec* 7.

Note 1. If the goods to be received and delivered be of different values, a double entry will be neceſſary: As, ſuppoſe a truſtee engaged in company with *A. B* each $\frac{1}{2}$, ſhould deliver 80 *l.* worth of broad cloth, in company, for tobacco to the value of 100 *l.*; in this caſe he enters twice: *1ſt, Tobacco in company* Dr to *Sundries, viz.* to *Broad cloth in company*, 80 *l.* and to *Caſh*, or *Dealer*, 20 *l.*; 2*dly*, *A. B. his accompt proper* Dr to *ditto his accompt in company*, 10 *l.* for his ſhare of the money now laid out or due to *Dealer*. Again, invert the ſuppoſition, and admit, that he delivers broad cloath in company to the value of 100 *l.* and receives 80 *l.* worth of tobacco, the reſt in money, or due by his dealer; in this caſe he enters alſo twice: *1ſt, Sundries* (*viz. Tobacco in company*, 80 *l.* and *Caſh*, or *Dealer*, 20 *l.*) Drs to *Broad cloth in company*; 2*dly*, *A. B. his accompt in company* Dr to *ditto his accompt proper*, 10 *l.* his part of money received, or due by *Dealer*.

Note 2. If you barter goods in company, for others which you take to yourſelf, enter alſo twice: *1ſt, Goods proper* received Dr to *Goods in company* delivered; 2*dly*, Each partner's *accompt in company* Dr to *ditto his accompt proper*, for his part of ſale. In like manner, if you barter goods of your own, for others which you bring into company, enter twice: *viz. 1ſt, Goods in company* received Dr to *Goods proper* delivered; 2*dly*, Each partner *his accompt proper* Dr to *ditto his accompt in company*, for his part of purchaſe.

Caſe 3. If you or partner withdraw juſt your or his exact part of goods in company remaining unſold, enter once, *viz.*

Goods proper, if withdrawn by you,
Partner's accompt in company, if by him,
} Dr

To *Goods in company*, for their value in company. *Dec.* 24.

Note

Note 1. If you or partner withdraw more or less than your or his exact part, you must account the goods sold, and enter as in [illegible] 1.

Note 2. When goods in company are all sold, or part sold, and the rest withdrawn, so that all are disposed of, make a double *Journal entry; viz.* 1*st*, *Goods in company* Dr to *Sundries*, *viz.* to *Cash*, or *Charges of merchandize*, for any charges not yet booked, such as cellar-rent, &c. and to *Profit and Loss* for your own commission, or for interest of money advanced by you. 2*dly*, Each partner *his accompt proper* Dr to *ditto his accompt in company*, for his part of the whole. *Nov.* 1.

N. B. This is also to be done, if it be a voyage in company.

Prob. 3. U. Debtor *and* Creditor *applied in payments betwixt trustee and partners.*

Case 1. If you the trustee receive payment of partner in money, charge *Cash* Dr to partner *his accompt-proper*, for the sum received. *Oct.* 27. *Nov.* 25.

2. If partner give you his bill on *E. F.* charge *Cash*, or *Bills receivable*, or *E. F.* Dr to partner *his accompt proper*, for value of the bill.

3. If you draw on partner, charge *Cash*, or *E. F. viz.* the man you deliver the bill to, Dr to partner *his accompt pooper*, for value of the bill.

4. If you pay partner in money, charge partner *his accompt-proper* Dr to *Cash*, for the sum paid. *Nov.* 4. and 17.

5. If you give partner your bill on *E. F.* charge partner his *accompt proper* Dr to *E. F.* for value of the bill.

6. If partner draw on you, charge partner *his accompt proper* Dr to *Cash*, if you pay at sight; if not, to *Bills payable.*

7. If, in adjusting shares in company, one partner pay into another, charge partner receiver *his accompt proper* Dr to partner payer *his accompt proper*, for the sum. *Nov.* 27. and 25.

N. B. The entry is the same, if you draw a bill upon one partner payable to another.

8. If partner make payment to *E. F.* of a debt due by the company, charge *E. F.* Dr to partner *his accompt proper.* *Nov.* 25.

Prob. 4. V. Debtor *and* Creditor *applied, when the company send goods to sea.*

Case 1. If the goods sent to sea have been formerly brought into company, and stand already entered in the books, upon shipping them off make a double entry; 1*st*,

Voyage in company to ——— Dr to *Sundries*, viz.
To *Goods in company*, for their value,
To *Cash*, for charges, as custom, insurance, *&c.*

2*dly*, Each partner *his accompt-proper* Dr to *ditto his accompt in company*, for his share of charges only.

Note. If partner pay the charges, the *Voyage* is charged Dr; not to *Cash*, but to partner *his accompt proper.*

Case 2. If the goods sent to sea are presently bought, (which is either from you, from a partner, or from a neutral person), enter also twice; namely, 1*st*,

Voyage in company to ——— Dr to *Sundries*, viz.
To { *Goods proper*, if bought of you,
Partner his accompt-proper, if of a partner,
Cash, or *Seller*, if of a neutral person; }
And
To { *Cash*, for charges, if paid by you,
Partner his accompt-proper, if by him. }

2*dly*, Each partner *his accompt-proper* Dr to *ditto his accompt in company*, for his part of the whole.

Note 1. If each partner find just his own part of goods sent to sea, you may enter thus: 1*st*, *Voyage in company to*-------Dr to *Sundries*, *viz.* To *Goods proper*, for your share; to each partner *his accompt in company*, for their respective shares; and to *Cash*, for charges, if paid by you, or to partner *his accompt-proper*, if paid by him. 2*dly*, Each partner *his accompt-proper* Dr to *ditto his accompt in company*, for his part of charges.

Note 2. But if each partner bring in such goods as they have proper for the intended voyage, without regard to their just proportions; being resolved to adjust that matter with money, the best way is, to consider the goods as bought, and enter accordingly; viz. 1*st*.

Voyage in company to--------Dr to *Sundries*, viz.
To each partner *his accompt-proper*, for value of the goods brought in by them,
To *Goods proper*, for value of those given in by you:
And,
To Cash, for charges, if paid by you,
To partner *his accompt proper*, if by him.

2*dly* Each partner *his accompt-proper* Dr to *ditto his accompt in company*, for their respective shares of the cargo and charges, and not for the value of the goods given in by them. *Nov.* 15.

Case 3. If you or partner commission your or his factor, to ship off goods to company's factor; upon receiving the invoice, enter twice; 1*st*,

Voyage in company to ——— Dr
To { *Factor my accompt-current*, if commissioned by you.
Partner his accompt-proper, if by him. }

2*dly*, Each partner *his accompt-proper* Dr to *ditto his accompt in company*, for his part of the whole.

Prob. 5. X. Debtor *and* Creditor *applied, upon advice from company's factor.*

Case 1. If you receive *per* advice from factor the *accompt of sales*, enter twice; *viz.* 1*st*, *Factor our accompt-current* Dr to *Voyage in company*, for the amount of neat proceeds. 2*dly*, Each partner *his accompt in company* Dr to *ditto his accompt-proper*, for his share of the whole.

Case 2. If factor in *Jamaica* advise you, that because he could not dispose of the goods to advantage, he has, according to orders, shipped them off to your factor at *Carolina*, enter twice; namely, 1*st*, *Voyage in company to Carolina* Dr to *Sundries*, *viz.* to *Voyage in company to Jamaica*, for value of the cargo outward, and to *Factor at Jamaica our accompt-current*, for new charges paid by him. 2*dly*, Each partner *his accompt-proper*, Dr to *ditto his accompt in company*, for his share of new charges.

Case 3. If the cargo outward be lost at sea, there are three varieties. 1. If none of the goods be insured, enter *Sundries* (*viz.* each partner *his accompt in company*, for his part of the loss, and *Profit and Loss*, for your own part) Drs to *Voyage in company*; and no second entry. 2. If the goods be all insured, enter twice; *viz.* 1*st*, Charge the *Insurers*, or *Cash* if you get present payment, Dr to *Voyage in company.* 2*dly*, Charge each partner *his accompt in company* Dr to *ditto his accompt-proper*, for his share of the sum received from, or due by the Insurers. 3. If only part of the goods be insured, enter also twice; 1*st*, *Sundries* (viz. *Insurers*, or *Cash*, for the value insured; each partner *his accompt in company*, for his share of the loss; and *Profit and Loss*, for your own share) Drs to *Voyage in company.* 2*dly*. Each partner *his accompt in company* Dr to *ditto his accompt-proper*, for his share of the sum received from, or due by the insurers.

Prob. 6. Y. Debtor *and* Creditor *applied, when returns are made by factor.*

Case 1. If you receive returns in goods, enter twice; namely, 1*st*, *goods in company received* Dr to *Sundries*, *viz.* to *Factor our accompt-current*, or to *Voyage in company*.

pany, if not yet difcharged, for value of goods; and to *Cash*, for charges here, if paid by you, or to partner *his accompt-proper*, if by him). 2*dly*, Each partner *his accompt-proper* Dr to *ditto his accompt in company*, for his fhare of faid charges.

Cafe 2. If you have return in bills, enter once; namely,
Cash, if remitted to you, and paid at fight, } Dr
Bills receivable, if remitted to you at ufance, } Dr
Partner his accompt proper, if remitted to him, } Dr
To *Factor our accompt current*, for value of the bill.

Cafe 3. If you or partner remit a bill to the factor, enter once, *viz. Factor our accompt current* Dr
To *Cash*, or the *Drawer*, if remitted by you, } for value of the bill.
To *Partner his accompt proper*, if by him, } for value of the bill.

Prob. 7. Z. Debtor *and* Creditor *applied in admitting a new partner*.

The entries to be made in admitting a new partner not being reducible to diftinct cafes, we fhall explain the matter by a particular example. Suppofe then yourfelf, as truftee, already in company with one partner *A.* each one half, for 300 *l.* and that you agree with *B.* to admit him as a third partner, upon his paying in 100 *l.* as his $\frac{1}{3}$ fhare of ftock; upon this fuppofition, the entries to be made are as follows.

1*ft*, You may either let the accompt of *Goods in company* ftand as it is, till the goods are fold, or balance it, by charging *Goods in company with A. and B.* Dr to *Goods in company with A.*

2*dly*, Charge *A. his accompt in company* Dr to *ditto his accompt proper*, 50 *l.* for his one half of the fale to *B.*

2*dly*, If *B.* prefently pay in his fhare of ftock, there are three varieties. 1*ft*, If he pay the whole to you, charge *Cafh* Dr to *B. his accompt in company*, 100 *l.* 2*dly*, If he pay the whole to *A.* charge *A. his accompt proper* Dr to *B. his accompt in company*, 100. *l.* 3*dly*, If he pay one half to you, and the other to *A.* charge *Sundries* (*viz. Cafh*, 50 *l.* paid in to you, and *A. his accompt proper*, 50 *l.* paid to him) Drs to *B. his accompt in company*.

4*thly*, If *B.* do not pay in his fhare of ftock prefently, then charge *B. his accompt proper* Dr to *ditto his accompt in company*, 100 *l.*; and when he pays, difcharge *his accompt-proper*, as above.

III. *Of the* Ledger.

The *Ledger* is the principal book, wherein all the feveral articles of each particular accompt, that lie fcattered in the other books according to their dates, are collected and placed together, in fpaces allotted for them, in fuch manner, that the oppofite parts of every accompt are fet directly fronting one another, on oppofite fides of the fame folio.

The Ledger is the chief or principal book of accompts, as being that which immediately anfwers the end of book-keeping. For, as has been already obferved, the Journal is only preparatory or introductory to the Ledger; and the Wafte-book contains only the matter of accompts, without either the form or order; whereas the Ledger has all the perfection of form and order aimed at in book-keeping, affording a ready anfwer to all the demands of the inquifitive merchant; and is therefore juftly efteemed the principal book of the three. It is called the *Ledger*, (an Italian word that fignifies *art* or *dexterity*), becaufe in it the artificial part of book-keeping chiefly appears. The Ledger, in oppofition to the fcattered order of things in the Wafte-book, has all the particular articles of each accompt collected and placed together; and that in fuch a manner, as to have the oppofite articles feparated, and fet fronting one another on oppofite fides of the fame folio. Thus, the oppofite articles of the Cafh-accompt are, the fums of money received, and the fums laid out; which accordingly ftand, the former on the Dr fide, and the latter on the Cr fide of the fame folio. Again, in an accompt of goods, the prime coft and charges go to the Dr fide, and the fales to the Cr fide; by comparing of which, appears the gain or lofs: and fo in other accompts.

The Ledger folios are divided into fpaces, for containing the accompts; on the head of which are written the titles of the accompts, marked *Dr* on the left-hand page, and *Cr* on the right: Below which ftand the articles, with the word *To* prefixed to the Dr fide, and the word *By* on the Cr fide. Upon the margin are recorded the dates of the articles, in columns allotted for that purpofe. The money-columns are the fame as in the other books. Before them ftands the folio-column, which contains figures directing to the folio where the correfpondent Ledger-entry of each article is made; for every thing is twice entered in the Ledger, *viz.* on the Dr fide of one accompt, and again upon the Cr fide of fome other accompt; fo that thefe figures mutually refer from the one to the other, and are of ufe in examining the Ledger.

For the ready finding any accompt in the Ledger, it has an alphabet, or index, wherein are written the titles of all accompts, with the number of the folios where they ftand.

Note. If the Ledger-accompts be numbered, 1, 2, 3, *&c.* according to their order; thefe numbers may be inferted in the Folio-column and Index, and ufed inftead of the folio figures. We have numbered the accompts of the following Ledger, but have not made this ufe of them; our defign being only to refer, by means of them, to the Ledger-accompts as occafion requires.

How the Ledger is filled up from the Journal.

To tranfport immediately from the Wafte-book to the Ledger, would, as has been formerly obferved, be a complex tafk, and require too great a meafure of thought and attention; but the former being firft reduced to a Jonrnal, the transferring from it to the Ledger becomes eafy, and may be performed by the following

RULES.

1. Turn to the Index, and fee whether the debtor of the Journal poft to be tranfported be written there: If it be not, inferr it under its proper letter, with the number of the folio to which it is to be carried.

2. Upon the folio, and in the head of the fpace allotted for the accompt, write the title in a large text letter for

for ornament, making it *Dr* on the left side of the folio, and *Cr* on the right.

3. Record the date in the columns on the margin of the Dr side, and write the Cr with the word *To* prefixed to it, immediately below the title, or other articles formerly posted; and complete the entry in one line, by giving a short hint of the nature and terms of the transaction, carrying the sum to the money-columns; and insert the quantity, if it be an accompt of goods, *&c.* in the inner columns, and the referring figure in the folio-column.

4. Turn next to the creditor of the Journal post, and proceed in the same manner with it, both in the Index and Ledger; with this difference only, that the entry is to be made upon the Cr side, and the word *By* prefixed to it.

5. The post being thus entered in the Ledger, return to the Journal, and, on the margin, mark the folios of the accompts, writing the folio of the Dr above, and the folio of the Cr below, a small line drawn between them, thus, $\frac{4}{2}$. These marginal numbers in the Journal are a kind of Index to the Ledger, and are of use in examining the books, and on other occasions.

6. In opening the accompts in the Ledger, follow the order of the Journal; that is, beginning with the first Journal post, allow the first space in the Ledger for the Dr of it, the next for the Cr, the third for the Dr of the following post, if it be not the same with some of those already opened; and so on till the whole Jonrnal be transported.

The above six rules are formed for simple posts, where there is but one Dr and one Cr; but may easily be applied to complex ones: *e. g.* In posts where only one of the terms is complex, the simple term is entered Dr to, or Cr by Sundries, or Sundry-accompts, referring to the Journal for particulars. And the single Drs or Crs of the complex term, are each of them, in their respective accompts, entered Dr to, or Cr by the simple term. Again, in posts where both terms are complex, each particular Dr and Cr are entered Dr to, or Cr by, Sundry accompts, with a reference to the journal, as before. And here observe, that an article of Sundry-accompts has no referring figure in the folio-column, because it refers to several accompts: But this defect is supplied by the marginal numbers of the Journal, which must still be consulted before the particulars of the indefinite article can be known.

How to transpose an account from one folio to another.

When the space allotted for an accompt proves too little: that is, when either the Dr or Cr side, or both, are so charged and filled with articles, that they can hold no more; the accompt must be transposed to a new space: Which may be done by one or other of the methods following.

1. In all accompts that have inner columns for the quantities, such as Accompt of goods, *&c.* add up both the Dr and Cr sides, and charge the new accompt Dr to the old, for the total of the Dr side; and make the old accompt Dr to the new, for the total of the Cr side. Thus the old accompt will be evened; that is, the sums and quantities on both sides will be equal; and the new accompt will exhibit the same sums and quantities on its Dr and Cr sides, that the old did, before it was transposed.

2. In accompts that have no inner columns, such as Personal accompts, Cash-accompt, Profit and Loss, *&c.* where the difference betwixt the two sides is only considered, it is sufficient, after adding up both sides, as before, to carry the balance or difference only to the new accompt, by making it Dr to the old, for the said balance, if the Dr side of the old be heaviest; but if the Cr side be heaviest, then charge the old accompt Dr to the new. See N° 1. and 61.

Note. The number of the folio on which the new accompt is opened, must be inserted in the Index, and also in the folio-column of the old accompt; and again, the folio-number of the old must be written in the folio-column of the new; that the accomptant may readily turn from the one to the other, as occasion requires.

How the Books are examined.

An accomptant should be at all imaginable pains in filling up the books, to make them exact and correct: But as errors must happen, the examination of the books after they are written up becomes absolutely necessary.

1. The Waste-book being the first and fundamental book, the only means left for discovering errors in it, are, a careful reading of it, and comparing it with the accomptant's memory, or the Book of letters, or Letters of correspondents, Bills, Invoices, *&c.*; or perhaps some accident or circumstance may happen to bring things to remembrance. And this, with casting up the sums of money anew, is all that can be done.

2 In revising the Journal, compare each post with the Waste-book, to see if the sums of money be right, and whether the narrative or reason of the entry be justly expressed. Next, Consider whether the true Dr and Cr are assigned; and, after having thus narrowly examined the posts, and corrected what happens to be wrong, return to the Waste-book, and, on the margin opposite to the revised post, make a dash with the pen, thus, /, to signify that the Journal has been compared with it, and found right.

3. The Ledger is revised or examined, by comparing it with the Journal, in the manner following. Take the Journal, and, beginning with the first post, turn (as the marginal numbers direct) to the folio of the Ledger where the Dr of the said post stands, and see whether it be duly entered: And, upon finding it right return to the Journal, and affix to the marginal number of the said Dr a dot or point, thus [.], to shew that it has been examined. Next, Turn to the folio where the Cr is posted, and, upon finding it right, or after correcting it if wrong, return to the Journal, and affix a dot to its referring figure

figure in the margin, for the same purpose as before. If there be more Drs or Crs in the post, proceed the same way with each of them. And thus go on with the next post, and after it with the third, *&c.* till the whole Journal and Ledger be compared.

As every thing is twice entered in the Ledger, once upon the Dr side of one accompt, and again upon the Cr side of some other accompt; it is plain, that the total sum of all the money on the Dr sides will be precisely equal to the total sum of all upon the Cr sides: And therefore the accomptant, after revising the books, is next, for further satisfaction, to add up the Dr sides of the whole Ledger into one sum, and the Cr sides into another. If they agree, it is highly probable that all is right; if they differ, something is unquestionably wrong.

This addition of the Dr and Cr sides is, by merchants, called the *Trial-balance*; and ought to be made, not simply by taking the sum of every page, but by summing the Dr and Cr sides of every account separately, and then adding these on every page into one sum. By going to work in this manner, you lose no labour; for when you come afterwards to close the accompts, instead of adding their Dr and Cr sides anew, you take their sums from the trial-balance.

If, after the revise is made, the totals of the Dr and Cr sides agree, the accomptant may, without further trial, conclude the books to be right. But if they differ, his next step is to examine the Ledger by itself. Which is done thus: Beginning with the first accompt, compare the first article on the Dr side with its counter-part (to which the referring figure directs), and, upon finding them right, or making them so, affix a dot to the end of the sum, or in the folio or month column of each of them, thus [.], to signify that they have been compared. Proceed in like manner with all the other articles on the Dr side, and next with those upon the Cr side; and then go on to a new accompt, and from it to the following, till the whole Ledger be finished. Here observe, that, in prosecuting the examination, all the dotted articles you come to are to be omitted, as having been compared already. The Ledger, being thus examined, if the corrections of the errors found bring the sums of the Dr and Cr sides to a balance, the books may now be presumed right; but if not, something is still wrong: And there is no way left to discover the mistake, but a more careful research of the books.

This revising or examination is what merchants call *Pricking of the books*; and should not be put off till the Ledger is filled up, but performed weekly, and in due order; that is, the Waste-book should be revised, before it be posted to the Journal; and the Journal ought to be examined, before it be transported to the Ledger; and the revising of the Ledger finished, before the balance is begun.

How Errors are corrected.

In explaining the method of correcting errors, we shall join the Waste-book and Journal together, because the manner of correcting is the same in both; and then shew the way of correcting mistakes in the Ledger.

I. Errors in the Waste-book and Journal may be reduced to six classes, and corrected as follows.

1*st*, If the errors be the omission of a whole post, the way to correct or supply the defect is, to write it in a separate place by itself, with a reference to it from the place where it should have been. 2*dly*, If only a word or two be wanting, they may be interlined or written upon the margin. 3*dly*, If a whole post be repeated, or twice written, it is corrected by cancelling one of them; but the cancelling ought to be done in such a slight manner, that the original writing may still be legible and distinct. 4*thly*, In like manner, if only a word or sentence be repeated, let one of them be slightly cancelled. 5*thly*, If there be any wrong name, word, or figure, the best way is, to let the wrong name, word, or figure, stand as they are, but correct the mistake by a note on the margin or foot of the page. 6*thly*, If you commit a mistake, and presently discover it in the very time of writing, the handsomest way of correcting it is, not to alter or cancel any thing, but to write the post or sentence anew, beginning with such a phrase as this, *I say*; as in the following example: *Sold A. B.* I say, *Bought of A. B.*

II. Errors in the Ledger are of four sorts. 1*st*, When an article is entered upon a wrong accompt: This is to be corrected, first, by making the other side of the said accompt Dr to, or Cr by Error, for the sum of the said article; which rectifies this accompt: After which, the article must be entered in due form in the accompt to which it belongs; or rather make the correction thus, *viz.* charge the one accompt Dr to the other, for so much *per error*. By either of these methods, the error is removed, and the purity of the books restored. 2*dly*, When an article is entered in the right accompt, but upon the wrong side; that is, upon the Dr side, when it should have been upon the Cr side, or *vice versa*; to correct this, the first thing to be done is, to remove the error, by making the other side of the said accompt Dr to, or Cr by Error, for the sum of the article: After which, the article must be entered anew upon the right side, as if no such blunder had happened. 3*dly*, When there is an error in a sum of money: This, if it be too little, is corrected by a new charge on the same side, for the defect; and if it be too much, the mistake is rectified by a discharge on the opposite side for the excess, *viz.* the accompt is debited or credited to, or by *ditto person*, or *ditto goods*, for so much short-posted, or over-charged. 4*thly*, When an article is quite forgot, or neglected, errors of this nature are easily adjusted, *viz.* by making the entry omitted; only observe, that it is not to be crouded in betwixt two former entries, in order to make it possess the place it would have done, had it come regularly in; for though the order, whatever it be, can occasion no error in the issue, yet this interlining would look more confused and irregular than the disorder of the date, which any person skilled in book-keeping will easily perceive to have happened through mistake.

Of balancing the Ledger, and raising from it an Inventory, to begin a new Set of Books.

Merchants commonly once a-year balance or close their Ledger, and raise from it the materials of an Inventory to a new set of books, for the ensuing year. Now,

Now, to make the method of doing this plain and intelligible to a learner, it muſt be obſerved, that, by the word *Balance*, merchants underſtand the difference betwixt the ſums on the Dr and Cr ſides of any accompt. Which difference being entered on the defective ſide, the accompt is ſaid to be balanced; that is, to have the ſums of the Dr and Cr ſides evened, or made equal. And the ſides of the ſeveral accompts throughout the Ledger being thus evened, and the total ſums formally ſet down on the foot of the accompts, the Ledger is ſaid to be balanced, cloſed, or finiſhed. Again, in order to underſtand how the new Inventory is formed from the old Ledger, it muſt be obſerved, that theſe balances or differences of the ſides of accompts, are of different kinds. In ſome accounts, the balance is, the gain or loſs made upon the ſale of goods; in ſome, the balance is, the price of goods remaining unſold; and in others, it is a debt due to, or by the merchant, *&c.* Now, balances of the firſt kind, *viz.* of gain or loſs, muſt be diſtinguiſhed from the reſt, and carried to the Profit and Loſs accompt; which being done, the balance or difference of its ſides, will be the gain or loſs made upon one year's trade, and goes to the Stock-accompt. All the other kinds of balances muſt be brought together into one ſpace or folio, under the title of *Balance-accompt*, and are the very articles of which the Inventory is made up. The moſt natural method of balancing the Ledger is, firſt to point out what is contained upon the Dr and Cr ſides of each accompt, and conſequently what the balances are; and then, to ſhew the mercantile and approved way of going to work, in cloſing the Ledger, collecting the balances, and converting them into a new Inventory. This we ſhall do in the form of problems.

PROB. I.

What the Balances in the Accompts of proper Trade are.

§ 1. *What the Balances in proper domeſtic Trade are.*

1. *Caſh-accompt*, N° 1. and 61.

Contains, upon the Dr ſide, the ready money which the merchant had at firſt, or when the books were begun; together with all he has received ſince that time. The Cr ſide contains all the payments he has made, or the money he has given out. So that the difference of the two ſides is, the ready money he has by him; and therefore this accompt is cloſed, by being credited by Balance, for the ſaid difference.

2. An *Accompt of Goods*, N° 2. 3. 11. 12. 14. 18. 20. 21. 27. *&c.*

Contains upon the Dr ſide, the prime coſt and charges; and, upon the Cr ſide, the ſale or diſpoſal of them. So that there are here three varieties. 1. When the goods are all diſpoſed of, which is known by the inner columns being equal, the difference of its ſides is, the gain or loſs made upon the ſale; and ſo is cloſed, by charging it Dr to Profit and Loſs, for the gain, if the Cr ſide be heavieſt; or giving it credit by Profit and Loſs, for the loſs, if the Dr ſide be heavieſt. N° 2. 11. 14. 18. *&c.* 2. When none of the goods are diſpoſed of, which will appear by the Cr ſide being empty, then it is cloſed by Balance, for the whole ſum on the Dr ſide. N° 21. 27. *&c.* 3. When only part of the goods are diſpoſed of, which will appear by the inequality of the quantity-columns; this caſe requires commonly two cloſing entries, *viz.* Firſt, the accompt muſt be credited by Balance, for the goods remaining, valued at the prime coſt; which equals the inner columns: After this, if the money-columns be unequal, it muſt be made Dr to, or Cr by Profit and Loſs, for the gain or loſs made upon what are ſold; which evens the outer columns, and cloſes the accompts. N° 3. 12.

Note 1. If the goods are of different kinds or prices, as they ſhould be diſtinguiſhed, when poſted to the Ledger, by different numbers, or ſeparate inner columns; ſo care muſt be taken, in balancing the accompt, to mention the kind of goods remaining unſold, and to value them at their own prices.

Note 2. A merchant may, at any time, know what goods he has on hand, by comparing the inner columns of the Accompts of Goods, without being put to the trouble of inſpecting his warehouſe, and weighing or meaſuring the goods themſelves.

Note 3. If there be inlack or outcome of goods, that is, defect or exceſs in weight or meaſure, it will happen, when the goods are all diſpoſed of, that the inner columns will not be equal. In this caſe, the balance or equality muſt be reſtored, by inſerting as much in the deficient column as will make it equal to the other, writing the words *Inlack*, *Broke*, *Loſt in weight*, *Ullaged*, *Outcome*, or the like, before it, as the reaſon why it is added: but nothing goes to the money-columns.

3. *Plate and Jewels.*

This account contains, on the Dr ſide, the things of that kind you are poſſeſſed of; and, like an accompt of goods remaining on hand, is cloſed, by being credited by Balance.

4. *Perſonal accompts*, N° 5. 6. 7. 9. 10. 13. 15. *&c.*

Contain, upon the Dr ſide, the debts due by the perſon to the merchant, with the payments made upon any other ſcore by the merchant to him. The Cr ſide contains the payments made by the perſon to the merchant, with the debts due by the merchant to the ſaid perſon, upon any other dealings. So that there are here two caſes. *1ſt*, If the Dr ſide be heavieſt, the difference is a debt due by the perſon to the merchant. N° 13. 24. *&c.* *2dly*, If the Cr ſide be heavieſt, the difference is a debt due by the merchant to the perſon. N° 15. 57. And in both caſes the accompt is cloſed, by making it Dr to, or Cr by Balance, for the difference of its ſides.

5. *Bills receivable*, N° 25.

This is a general perſonal accompt, and contains upon the Dr ſide, bills accepted, and payable to the merchant. The Cr ſide contains the payments he has received. So that the difference of its ſides (if there be any) is, what is yet unpaid: And the accompt is cloſed, by giving it credit by Balance, for the ſaid difference.

6. *Bills*

6. *Bills payable*, N° 52.

This is an accompt of the ſame nature with the former; and contains, upon the Cr ſide, the bills accepted by the merchant, payable to others; and, upon the Dr ſide, the payments he has made. So that the difference of the ſides (if there be any) is the bills yet unpaid: And the accompt is cloſed, by charging it Dr to Balance.

7. *Bills of Exchange.*

This accompt exhibits, on the Cr ſide, all the bills you draw on your factors or correſpondents; and the Dr ſide ſhows what of them are accepted, proteſted, or yet out-ſtanding; and is cloſed, if the ſides happen to be unequal, by being debited to Balance, for the bills out-ſtanding, *viz.* the bills of whoſe acceptance you have hitherto had no advice.

8. *Bonds.*

This accompt exhibits, on the Dr ſide, all the bonds you have received, and on the Cr ſide, what of them are paid, or out-ſtanding; and is cloſed, if the ſides happen to be unequal, by being credited by Balance, for the bonds yet unpaid.

9. *Suſpenſe-accompt*, N° 34.

Contains, upon the Dr ſide, the goods ſent off; and upon the Cr ſide, either the ſame goods returned, or advice from your correſpondent that he deſigns to keep them, or the price ſent up. So that either the ſides of this accompt are equal, and then the accompt cloſes of itſelf; or, if there be any difference, it is owing to your having hitherto had no advice concerning ſome of the goods ſent off; and in this caſe the accompt is cloſed, by being credited by Balance, for the ſaid difference.

10. *Foreign Coin*, N° 26.

Contains, upon the Dr ſide, the value at which the ſeveral pieces are received; and on the Cr ſide, the value at which they are put off. In cloſing this accompt, there are three caſes. 1*ſt*, If the pieces are all diſpoſed of, the accompt is cloſed, by being debited or credited to or by Profit or loſs, for the gain or loſs made by them. 2*dly*, If none of the pieces are yet diſpoſed of, it is cloſed by being credited by Balance, for the whole value on the Dr ſide. 3*dly*, If part of them are diſpoſed of, and part of them yet on hand; in this caſe, the accompt muſt firſt be credited by Balance, for value of the pieces on hand; and if after this the money-columns ſtill remain unequal, it muſt be debited or credited to or by Profit and Loſs, for the ſaid difference; which is the gain or loſs made upon the pieces diſpoſed of.

11. *Wagers Accompt.*

Contains, upon the Dr ſide, the conſignments made when the wagers were entered into. The Cr ſide contains the deciſions of the wagers. So that here occur two varieties, *viz.* 1*ſt*, If all the wagers are determined, the difference of the ſides will be the gain made upon thoſe decided in favour of the merchant; and the accompt is cloſed, by being charged Dr to Profit and Loſs, for the ſaid difference. 2*dly*, If any of the wagers are yet undecided, the accompt muſt firſt be credited by Balance for them: After which, if the ſides are ſtill unequal, it muſt be charged Dr to Profit and Loſs, for the difference.

12. *Deceaſed Perſon's Eſtate.*

The Dr ſide of this accompt exhibits the legacies, bills, or debts, you the executor have paid on account of the perſon deceaſed; and the Cr ſide ſhows what he died poſſeſſed of: And the accompt is cloſed, by being made Dr to Profit and Loſs, for the difference of its ſides; which is the ſum that falls to you the executor.

13. *Accompts of Ships, Houſes, and other Poſſeſſions*, N° 4.

Contain, upon the Dr ſide, what they coſt at firſt, or are valued at, with all charges, ſuch as repairs, or other expences laid out upon them. The Cr ſide contains, (if any thing be writ upon it), either what they are ſold or exchanged for, or the profits ariſing from them; ſuch as freight, rent, *&c.* Here there are three caſes. 1*ſt*, If nothing be written upon the Cr ſide, it is cloſed, by being credited by Balance. 2*dly*, If the Cr ſide be filled up, with the price of the ſhip, houſe, *&c.* ſold, or otherwiſe diſpoſed of, then the difference of the ſides is the gain or loſs made upon the ſale; and the accompt is cloſed, by being debited or credited to or by Profit and Loſs. 3*dly*, If the Cr ſide contain only the freight or rent; in this caſe, firſt charge the ſhip, houſe, *&c.* Dr to Profit and Loſs, for the freight or rent; and then cloſe the accompt with Balance. N° 4.

14. *Houſe-expences, Charges of Merchandize, Refuſal of Bargains, Intereſt-accompt, Inſurance-accompt*, and all others of the like nature, that are diſburſements for which nothing comes in, or pure incomes for which nothing goes out. N° 65. 42. 35.

Contain, upon their Dr ſides, the articles of loſs, and upon the Cr ſides the articles of gain; and are cloſed, by being debited or credited to or by Profit and Loſs, for the difference of their ſides.

15. *Profit and Loſs*, N° 38.

Contains, upon the Dr ſide, the articles of loſs, and on the Cr ſide the articles of gain. To this accompt are carried, not only whatever comes in courſe to it from the Journal, but alſo all the articles of gain and loſs that occur in cloſing the Ledger-accompts. After which, the Dr and Cr ſides being added up, their difference is the neat gain or loſs made ſince the books were begun; and therefore this accompt is cloſed, by being debited or credited to or by Stock, for the difference of its ſides.

16. *Stock-accompt*, N° 8.

As gathered from the Journal, contains, upon the Dr ſide, the debts due by the merchant when the books were begun. The Cr ſide contains his ready money, effects, and debts due to him at the ſame time. But then, to this accompt, as it now ſtands, there is brought, at cloſing of the Ledger, the difference of the ſides of the Profit and Loſs accompt. After which, the Dr and Cr ſides being added up, and compared, their difference will be the merchant's preſent neat ſtock; and the accompt is cloſed by Balance.

§ 2.

§ 2. *What the Balances in proper Foreign Trade are.*

1. *Voyage to*, or *from* ———, N° 16. 40. 47.

Contains, upon the Dr side, the prime cost and charges of the cargo. The Cr side is either empty, or it contains the receipt or disposal of the goods by the factor, or perhaps returns made for them. There are therefore here two cases. 1*st*, If the Cr side be empty, the ship is still at sea, or, at least, there has been as yet no advice of her arrival; and the accompt is closed, by giving it credit by Balance. 2*dly*, If the Cr side be filled up, the difference of the sides is the gain or loss made upon the voyage; and accordingly the accompt is closed by being made Dr or Cr to or by Profit and Loss. If the sums of the sides happen to be equal, there is neither gain nor loss on the voyage; and the accompt closes of itself.

2. *A. B. my Accompt of Goods.*

Contains, upon the Dr side, the goods consigned to, and received by the factor; and on the Cr side, the disposal of the said goods. This accompt balances exactly as an *Accompt of goods in proper domestic trade.*

3. *A. B. my Accompt on Time.*

Contains, upon the Dr side, the debts due to the factor, for my goods sold by him on time. The Cr side contains the payments made by debtors to the factors. So that, if there be any difference of the sides, it is the debts yet out-standing: And the accompt is closed, by giving it credit by Balance.

4. *A. B. my accompt-current*, N° 41. 53.

Contains, upon the Dr side, the money in the factor's hands, received by him of the sales of my goods, with the remittances I had sent him, or payments I have made him upon any other account. The Cr side contains the payments or remittances he has sent me, with the debts I owe him upon any other score. In closing this accompt, there are two cases. 1*st*, If the inner columns, which contain the foreign money, be equal; then, if there be any difference between the outer columns, it is the gain or loss made by exchange; which flows from the different rates of exchange at which these debts have been charged and discharged: And the accompt in this case is closed, by being made Dr to or Cr by Profit and Loss, for the difference of the outer columns. 2*dly*, If the inner columns are unequal, they must first be brought to an equality, by making the accompt Dr to, or Cr by Balance, for their difference, valuing the foreign money at the current rate of exchange; which difference is a debt due by the factor if the Dr side be heaviest, but due to the factor if the Cr side be heaviest. If after this the outer columns are unequal, their difference is, the gain or loss made by exchange; and the accompt must be closed, by making it Dr to or Cr by Profit and Loss, for the said difference.

PROB. II.

What the Balances in Factory-accompts are.

1. *A. B. his Accompt of Goods*, N° 48.

This accompt contains, upon the Dr side, the charges paid by the factor. The Cr side contains the sale or disposal of the goods. In closing this accompt, there are five varieties. 1*st*, If the goods are all sold, and all the money received, this accompt is balanced, by being charged Dr, first to Profit and Loss, for the factor's commission, at so much *per cent.* after which, the difference of the sides is, the money due to the employer; and is closed, by being again charged Dr to *A. B. his Accompt-current*, for the said difference. 2*dly*, If the goods are all sold, but no money yet received, it is closed, by being made Dr to Profit and Loss, for the factor's commission, and to *A. B. his Accompt on Time*, for the out-standing debts due to him. 3*dly*, If the goods are all sold, and only part of the money received, it is closed, by being made Dr to Profit and Loss, for the factor's commission; to *A. B. his Accompt on Time*, for the out-standing debts; and to *A. B. his Accompt-current*, for the employer's money in factor's hands. 4*thly*, If none of the goods be yet sold, it is closed, by giving it credit by Balance, for the sum of the charges on the Dr side. 5*thly*, If only part of the goods are sold, and so the accompt unfinished, the best way to close it is, by a double balance; that is, first charge it Dr to Balance, for the sum upon the Cr side; and then give it credit by Balance, for the charges on the Dr side. Thus the accompt will appear in the new books in the same state that it did in the old.

2. *A. B. his Accompt on Time*, N° 49.

Contains, upon the Cr side, the debts due by those who bought the employer's goods; and as these debts are paid in to the factor, it is charged Dr to *A. B. his Accompt-current*, for the said payments; and therefore, if, at closing of the Ledger, there be any difference of its sides, it is the debts yet out-standing; and is closed, by being charged Dr to Balance, for the said difference.

3. *A. B. his Accompt-current*, N° 36. 50.

Contains, upon the Dr side, the money laid out by the factor for the employer's use, as in answering his bills, or remitting bills to him, or otherwise. The Cr side contains the money in the factor's hands belonging to the employer. So that the difference of its sides is, the debts due by the factor to *A. B.* or by *A. B.* to him; and the accompt is closed, by being made Dr or Cr to or by Balance.

Note, If the factor dispose of the employer's good on trust, to persons with whom he has private dealings of his own, it will be proper, in closing their accompts, to divide the balance into two parts, *viz.* one due for the employer's goods, and the other due to or by himself.

PROB.

PROB. III.

What the Balances in Company-accompts are.

§ 1. *What the Balances in the Accompts kept by a Partner are.*

1. *A. B. my Accompt in Company*, N° 54.

CONTAINS, upon the Dr fide, the partner's inputs, and fhare of charges; upon the Cr fide, the returns made; and the difference is the gain or lofs. In balancing this accompt, there are two cafes. *1ft*, If the accompt be finifhed, *i. e.* if the goods be fold, and returns made, it is clofed, by being made Dr or Cr to or by Profit and Lofs. *2dly*, If the accompt be yet unfinifhed, the beft way is, to clofe it with a double balance; that is, to make it Dr to Balance, for the fum of the Cr fide, and give it credit by Balance, for the fum of the Dr fide.

2. *A. B. my Accompt-proper*, N° 55.

This accompt is merely perfonal, and clofed with Balance, for the difference of its fides; which is the debt due to, or by the company.

§ 2. *What the Balances of the Accompts kept by a Truftee in his own Books are.*

BEFORE the truftee clofe the company's accompts, he ought to make the double Journal entry following, if it be not done already; namely, *1ft*, Goods in Company, or Voyage, *&c.* Dr to Sundries, *viz.* to Cafh, for all charges not yet ftated to accompt, fuch as cellar-rent, *&c.* and to Profit and Lofs, for his own commiffion, at fo much *per cent.* *2dly*, Each partner's Accompt-proper Dr to his Accompt in Company, for their refpective fhares of the above charges and commiffion. Thefe entries being made, the balances of the accompts are as follows.

1. *Goods in Company*, N° 58. 62. 71. 74.

Contains, upon the Dr fide, the prime coft of the goods ftocked in, with all charges, and the truftee's commiffion. The Cr fide contains the difpofal of them. The difference of the fides is gain or lofs, to be divided amongft the partners. Here there are three cafes. *1ft*, If the goods be all fold, the accompt is clofed, by being debited or credited to or by Sundries, *viz.* to, or by each partner's Accompt in company, for their fhares of the gain or lofs; and to, or by Profit and Lofs, for the truftee's own fhare. *2dly*, If none of the goods are fold, then the accompt is clofed, by being credited by Sundries; *viz.* by each partner's Accompt in Company, for their fhares of the goods unfold; and by Balance, for the truftee's fhare. *3dly*, If part of the goods are fold, and part of them yet remain not difpofed of, this cafe is a compound of the two former; and accordingly the accompt is clofed, by making the entry mentioned in the firft cafe, for the gain or lofs on thofe fold; and then, by making the ntry mentioned in the fecond cafe, for thofe not difpofed of.

2. *Voyage in Company*, N° 66.

Contains, upon the Dr fide, the value and charges of the goods fent to fea. The Cr fide contains the receipt or difpofal of them by the factor. The difference of the fides is gain or lofs. Here there are three cafes. *1ft*, If the Dr and Cr fides be eqnal, then the accompt clofes of itfelf. *2dly*, If one of the fides exceed the other, then the accompt is clofed, by being made Dr or Cr to or by Sundries; *viz.* to, or by each partner's Accompt in Company, for their fhares of the gain or lofs; and to, or by Profit and Lofs, for the truftee's fhare. *3dly*, If nothing be yet writ upon the Cr fide, then the accompt is clofed, by being credited by Sundries, *viz.* by each partner's Accompt in Company, for their fhares of the goods at fea; and by Balance, for the truftee's fhare.

3. *Factor our Accompt of Goods.*

Contains, upon the Dr fide, the company's goods configned to, and received by the factor. The Cr fide contains the difpofal of them. The difference of the fides is gain or lofs made upon the fale of them. This accompt has the fame varieties, and is balanced the fame way with *Goods in company.*

4. *Factor our Accompt-current.*

Contains, upon the Dr fide, what money belonging to the company is in the factor's hand. The Cr fide contains the returns he has made in goods or bills. The difference is the debt due to or by the factor. This accompt is clofed, by being made Dr or Cr to or by Balance, for the faid difference.

5. *Partner his Accompt in Company*, N° 59. 69. 70.

Contains, upon the Cr fide, the partner's inputs, with his fhare of charges, and of gain at clofe. The Dr fide contains returns for inputs difpofed of, or goods remaining unfold, with the partner's fhare of loffes, if any. This accompt, after the preceding accompts are balanced, will always clofe of itfelf; as is evident by confidering what goes to the two fides of it: fo that if the balance of this accompt fail, the accomptant may conclude, for certain, that fomething in the company's accompts is wrong, or at leaft fome miftake has happened in clofing them.

6. *Partner his Account-proper*, N° 60. 67. 68.

Is a perfonal account, the difference of whofe fides is the debt due to or by the partner, and is clofed with *Balance.*

Note. If the defign of balancing the company-accompts be, not in order to know the ftate of the company's affairs, but only that the old Ledger may be finifhed, and the accompts carried to new books; the accomptant, in this cafe, may either balance them as above directed; or he may, if he pleafes, clofe all of them by a double balance; which is the eafieft and fhorteft way, and will have the fame effect in the iffue.

§ 3. *What the Balances of the Accompts kept by a Truftee in feparate Books are.*

1. *Goods in Company, and Voyage in Company,*

HAVE the fame things upon their Dr and Cr fides, as when

when kept in books along with other businefs; but are clofed with *Profit and Lofs in Company*, for the gain or lofs; and with partners *Accompts in company*, for their refpective fhares of goods remaining unfold, or at fea.

2. *Cafh in Company*,

Contains, upon the Dr fide, the fums of money given in by partners, and received from dealers for goods fold; the Cr fide contains the fums laid out; fo that the difference of its fides is the money on hand; and is clofed with *Balance in company*.

3. *Partner his Accompt in Company*,

Contains the fame thing upon its Dr and Cr fides refpectively, as when kept in books along with other bufinefs; and, after the accompts of goods and voyages are balanced, will always clofe of itfelf.

4. *Partner his Accompt-proper.*

This and all perfonal accompts, as they contain the fame things upon their Dr and Cr fides, as their parallels, in proper trade, fo they are all clofed with *Balance in company*.

5. *Profit and Lofs in Company.*

The difference of its fides is the gain or lofs made upon company-trade, and muft be charged Dr to the truftee his Accompt-proper, for his commiffion; after which, it is clofed, (if no Stock-accompt is kept), by being made Dr or Cr to or by Sundries, *viz.* Each partner *his accompt in company*, for the refpective fhares of gain or lofs. But if you keep a *Stock-accompt in company*, then this accompt is clofed with it: and the Stock-accompt is again clofed with the partners *Accompts in company*.

6. *Balance in Company*,

Contains, upon the Dr fide, the company's ready money in the truftee's hand, with the debts to the company, whether by partners or dealers; the Cr fide contains the debts due by the company, and that whether to partners or to dealers: And if the books have been rightly kept, and duly balanced, the two fides of this accompt will always equal one another to a farthing.

Note. If you incline the goods remaining unfold, or at fea, fhould appear upon the Balance-accompt, you muft clofe the Accompt of goods and Voyages with *Balance in company*, for the value of the quantity not difpofed of, or at fea; and you may clofe the partners Accompts in company (which in this cafe will not clofe of themfelves), either with their *Accompts proper*, or with *Balance in company*, as you pleafe.

How the Balances are collected, the Ledger clofed, and a new Inventory formed.

When you defign to balance your Ledger, in order to begin a new fet of books, proceed in the manner following.

Take two fheets or folios of loofe paper, rule them like the Ledger, and write on the heads or tops of them, the titles of the two following Accompts, *viz.* on the head of the one, *Profit and Lofs Dr*, and *Contra Cr*; on the other, *Balance Dr*, and *Contra Cr*. Then, beginning with the Accompt of cafh, go over every accompt in the Ledger, (omitting only the Accompts of Profit and Lofs and Stock, which muft be left open to the laft), and carry the articles of gain or lofs found on any of them, to the Profit and Lofs fheet; and the articles of debt, or goods remaining, to the Balance fheet, without touching the accompts themfelves: *e.g.* Taking from the Trial-balance the fums of the Dr and Cr fides of the Cafh-accompt, fubtract the one fum from the other, and, on the Balance fheet, make Balance Dr to Cafh, for their difference, being the ready money in your hands. Again, in an Accompt of goods that are all fold, taking the fums of the Dr and Cr fides, fubtract the one from the other, and, on the other fheet, make Profit and Lofs Dr or Cr to or by the faid Accompt of Goods, for the difference of its fides. And in this manner proceed with every other accompt in the Ledger, according to their nature, as explained in the laft fection.

Having advanced thus far, your next ftep is, to add up the Dr fides of the Profit and Lofs fheet, and the Profit and Lofs accompt in the Ledger, into one fum, and their Cr fides into another; and, on the faid fheet, make Profit and Lofs Dr or Cr to or by Stock, for their difference: Which difference being carried to the Stock-accompt, add up its Dr and Cr fides, and carry their difference to the Balance fheet. Which being done, the total fums of the Dr and Cr fides of the Balance fheet will be equal to a farthing, if the books be right, and the balancing work truly performed: As may be thus demonftrated.

It is obvious, that the Balance fheet, before the balance of the Stock-accompt is brought to it, contains, upon the Dr fide, the money and goods you have on hand, or at fea, or in the hands of factors, with the debts due to you; the articles on the Cr fide are the debts due by you to others: So that the difference of its fides is your prefent worth, or neat ftock. Now, if the balance of the Stock-accompt be alfo equal to your prefent neat ftock, it is plain, that it will even the fides of the Balance-accompt. But that it is fo, appears thus.

Your prefent neat ftock is equal to your neat ftock when the books were begun, with the addition of the gain, or diminution of the lofs, made fince that time: but the difference of the fides of Stock accompt, before the balance of Profit and Lofs accompt be brought to it, is your neat ftock when the books were begun; and the balance of Profit and Lofs accompt, is the gain or lofs made fince that time; which, confequently, being brought to Stock-accompt, makes the balance of Stock-accompt equal to your prefent neat ftock; and therefore the balance of Stock-accompt evens the fides of Balance-accompt.

If, after the balance of Stock-accompt is brought to Balance-accompt, the fides happen to be ftill unequal, there has unqueftionably fome error been committed; which you muft find out by a careful review of the balancing work: for here the error muft lie, fince the books are fuppofed to have been examined, and found right, or made fo, before the balancing was begun. On the other hand, if the fides of Balance-accompt be equal, all

all may be presumed right. There is not, indeed, an absolute certainty in the case: for, if you imagine two mistakes committed, either both in the articles of Profit and Loss, or both in the articles of Balance, or one in the former, and the other in the latter, both excesses, or both defects, equal, and on opposite sides, it is plain this would not impede the equality of the Dr and Cr sides of the Balance-accompt. But then this is so great a chance, that it is more than probable such a thing can never happen, and pass too, without being discovered.

Having brought the two sides of the Balance-accompt to an equality, which is the test of every thing being right, proceed to close the Ledger-accompts, thus. First, to the Profit and Loss accompt, transfer the articles on the Profit and Loss sheet. Next, at the end of the Ledger, erect an Accompt of Balance, into which transcribe the Balance sheet. After which, return to the beginning of the Ledger, and giving the Cash-accompt credit by Balance, for your ready money, draw a line cross the money-columns on each side, at the foot of the accompt; below which set down the total sums, which will be now equal. Proceed in like manner with all the following accompts, transferring to each the respective articles that belong to them, from the two sheets of loose paper, inserting the referring figures in the folio-column, and writing the total sums on the foot of the accompt; by which means all the accompts in the Ledger will come to be balanced and closed; that is, evened and finished.

But here it will be proper to observe, that merchants, in balancing their Ledger, do not all go the same way to work. For some, instead of proceeding according to the above directions, close their Ledger-accompts, and post the closing entries to the Accompts of Profit and Loss, and Balance, all at the same time. And it must be owned, that this way, practised with care, will well enough answer the purpose; but to post the closing entries in the first place, and then to close the accompts, seems to be the surer and better method.

The Ledger being now closed, the next thing to be done is, to begin a new set of books; in order to which, a new inventory must be fetched from your old books, as the foundation of your future trade in the new. Now, it is plain, at first view, that the several articles on the Dr side of the Balance-accompt, being the particular items of your effects, and debts due to you, make up the first part of the Inventory; and the several articles on the Cr side, except the last, being the debts due by you to others, make up the second part of it: and accordingly in your new Journal, the several particulars on the Dr side must all of them be made Drs to *Stock*, and *Stock* Dr to the several particulars on the Cr side; and Stock-accompt in your New Ledger will stand thus:

Stock Dr,	*Contra* Cr,
To Jacob Russel,	*By Cash,*
To H. V. Beek,	*By Indian chints,*
&c.	&c

(1)

WASTE-BOOK.

Edinburgh, the 1st of *January* 1769.

					l.	s.	d.
An Inventory *of the money, goods, and debts belonging to me* A. B. *as also of the debts due by me to others,* viz.	l.	s.	d.				
I Have in ready money -	12000	00	0				
Also 2000 yards fine linen, at 2*s.* 6*d.*	250	00	0				
——15 pieces *Indian* chints, at 24*l.* 10*s.*	367	10	0				
——¼ of the ship *Britannia* (freighted by Mr *Steel* and comp. for a voyage to *Barbadoes*) with repairs, cost	348	10	0				
——*John Harris* owes me *per* note, on demand,	45	00	0				
——*Thomas Freeman* owes me *per* bill, due 2d *February* next, - -	96	00	0				
/ ——*George Evans* owes me *per* bond, dated the 11th *Nov.* last, and payable *Mart.* next, with interest at 5 *per* cent. - -	300	00	0				
					13407	00	00
I owe as follows.							
/ To *Joseph Martin*, on demand, - - -	36	00	0				
To Sir *Isaac Crisp*, due 1st of *June* next, -	120	00	0				
					156	00	00
A.							
——6th.——							
/ Bought for ready money, 40 pieces cambrics, at 2 *l.* 16 *s.* - - B. 1. F. 1.					112	00	00
——10th.——							
/ Bought of *John Vernon* 100 pieces duroys, at 26 *s.* to pay at two months, B. 3.					130	00	00
——15th.——							
/ Paid *Joseph Martin* in full, - F. 4.					36	00	00
/ Bought of *Jacob Russel* 26 pieces druggets, at 7 *l.* 10 *s.* - -	l.	s.	d.				
Paid half down, - -	97	10	0				
Rest due on demand, -	97	10	0				
					195	00	00
B. 5.							

WASTE-BOOK. (2)

W. B. No						l.	s.	d.
	——January 21st.——							
1. 2. /	Sent as an adventure to *Jamaica*, in the ship *Hopewell*, Captain *Gordon* master, consigned to *William Boyd*, the following goods, marked and numbered as *per* margin, *viz.*	l.	s.	d.				
	70 pieces of my own duroys, at 26 *s.*	91	00	0				
	6 pieces holland, presently bought of *Jacob Green*, at 18 *l.* to pay at 2 months,	108	00	0				
	Paid charges, till on board,	14	11	4				
	Paid also premium to *Simon Smith* and company, for insuring 200 *l.*	10	00	0				
						223	11	04
	G. 4.							
	——30th.——							
/	Paid *Jacob Russel*, in full for druggets, F. 4.					97	10	00
	——February 2d.——							
/	Bought of *Edward Harley* 1000 yards broad cloth, at 13 *s.* 6 *d.*	l.	s.	d.				
	Paid him part in money, -	330	00	0				
	Given him a bill on *John Harris* for	45	00	0				
	Rest due at 3 months, -	300	00	0				
						675	00	00
	B. 7.							
	——5th.——							
/	Received of *Thomas Freeman* in full, E. 4					96	00	00
	——16th.——							
/	Bought for present money the goods following, *viz.*	l.	s.	d.				
	90 pieces kerseys, at 6 *l.* -	540	00	0				
	120 pieces fustians, at 37*s.* 6*d.*	225	00	0				
						765	00	00
	B. n. 1.							
	——25th.——							
/	Sold 10 pieces druggets, at 8 *l.* 3 *s.* for ready money, - - - C. 1. E. 1.					8.	10	00
	——March 1st.——							
/	Sold *George Young* 400 yards broad cloth, at 14 *s.* to pay at 1 month, - - C. 3.					280	00	00
	——4th.——							
/	Sold *John Keil* my 90 pieces kerseys, at 6 *l.* 7 *s.*	l.	s.	d.				
	Received in part, - -	300	00	0				
	Rest due at 20 days, - -	271	10	0				
						571	10	00
	C. 5.							
	——10th.——							
/	Paid *John Vernon*, in full for duroys, F. 4.					130	00	00
/	Lent *Jacob Spencer*, upon bond, for 6 months, at 5 *per cent.* - - - F. 2.					1000	00	00

March

(3) WASTE-BOOK.

	l. s. d.
March 17th.	
Sold *Jacob Preston* 200 yards broad cloth, at 14*s.* and 2*d.* for payment whereof he has given me a bill on *Henry Sidney*, payable at sight; the sum is - - - -	141 13 04
C. 2. F. n. 4.	
22d.	
Sold *Richard Stone* 400 yards broad cloth, at 14*s.* $3\frac{1}{2}$*d.* which he has paid, as follows, *viz.*	
Given me 26 moidores, at 27*s.* — 35 02 0	
Given me in *British* coin, — 150 14 8	
And for the rest, an assignment on *G. Digby*, - - — 100 00 0	285 16 03
C. 4. F. n. 8.	
23d.	
Paid *Jacob Green* in full for holland, as follows, *viz.*	
Given him my 26 moidores at 26*s.* 6*d.* — 34 09	
And the rest in *British* coin, - — 73 11	108 00 00
F. 4. & n. 8.	
Received of *Henry Sidney*, in full of *Jacob Preston*'s bill,	141 13 04
E. 4. F. n. 4. & 9.	
April 1st.	
Received of *John Keil*, in full for kerseys, the sum of - - — 280 00	
Abated him, on account he complains two of the pieces proved not so good as the rest, - - — 1 10	271 10 00
E. 6.	
6th.	
Received of *George Young*, in full for broad cloth.	280 00 00
E. 4.	
10th.	
Bartered 2 pieces *Indian* chints, at 25*l.* for 40 pieces lockrams, of the same value, *viz.* at 25*s.*	50 00 00
D. 1.	
16th.	
Bartered 1000 yards linen, at 2*s.* 8*d.* for the following goods of the same value, *viz.*	
1 C. cochineal, valued at — 108 16 0	
64 lb. cinnamon, at 7*s.* 8*d.* — 24 10 8	133 06 08
D. 3.	
22d.	
Bartered 6 pieces *Indian* chints, at 24*l.* 15*s.* for	
8 bales muslin, at 12*l.* 16*s.* — 102 8	
The balance I have received in money — 46 2	148 10 00
D. n. 2.	

WASTE-BOOK. (4)

	l. s. d.
April 30th.	
Bartered with *George Dennis*	
1000 yards linen, at 2*s.* 9*d.* — 137 10 0	
And 2 pieces *Indian* chints, at 25*l.* — 50 00 0	187 10 00
For 17 bags cotton, containing 42 C. 2 Q. neat, at 3*l.* 15*s.* *per* C. - - — 159 07 6	
And 12 lb. cloves, at 9*s.* 1*d.* — 5 09 0	164 16 06
D. 4.	
May 3d.	
Paid *Edward Harley*, in full for broad cloth	70 00 00
F. 4.	
7th.	
Sent *Nathaniel Napier*, in the country, 16 pieces druggets, desiring him to take them at 7*l.* 15*s.*; if not, to return them on my charges. - -	124 00 00
C. n. 4.	
13th.	
Paid *Simon Smart*, as a penalty for refusing a bargain of *Norwich* stuffs, - -	2 02 00
B. n. 2.	
18th.	
J. J. No 1. 2. Shipped on board the *Swan*, *Robert Scot* master, by order and for account of *John Jessop* merchant in *Genoa*, the following goods, marked and numbered as *per* margin, *viz.*	
8 tun lead, bought of *George Dennis*, at 13*l.* 10*s.* to pay at 1 month, - - — 108 00	
7535 lb. tanned leather, presently bought for ready money, at 7*d.* - - — 219 16	
Paid custom and other charges — 10 19	
Due to *George Aiton* for packing, — 1 05	
My commission at $2\frac{1}{2}$ *per cent.* — 8 10	
Paid *Simon Smith* and company, for insuring 350*l.* on the whole, — 10 10	
My commission on ditto, at $\frac{1}{2}$ *per cent.* - - — 1 15	360 15 00
O. n. 1. 2. 3.	
22d.	
Paid *George Aiton*, in full for packing *John Jessop*'s leather, - - -	1 05 00
O. n. 3.	
31st.	
Drawn my bill on *John Jessop* in *Genoa*, for 960 dollars, payable to *George Stapleton*, or order, for value here received, at 50*d.*	200 00 00
P. 3.	
June 3d.	
Dr *George Friend* is deceased, and has left me a legacy, payable by his executor *John Vernon*, the sum is - -	200 00 00
E. n. 5.	
8th.	
Paid Sir *Isaac Crisp* in part, - -	80 00 00
F. 4.	

June

(5) WASTE-BOOK. *l. s. d.*

——June 16th.——

/ *Nathaniel Napier* writes me, that he designs to keep the 16 pieces of druggets sent him the 7th of May last, and promises payment, *viz.* the one half against the 1st of *August* next, and the other half at *Martinmas*, the whole being - - - - 24 00 00

C. n. 4.

——18th——

/ Received advice from *William Boyd* in *Jamaica*, That he hath received and sold my adventure, the neat proceeds, as *per* accompt of sales, amounting to 304*l.* 7*s.* In return for which, he hath put on board the same ship the following goods, desiring me to draw for the rest, *viz.*

	l.	*s.*	*d.*
6 barrels indigo, containing 126 lb. *per* barrel, at 2*s.* 2*d. per* lb.	81	18	00
5 hogsheads pymento, containing in all 1535 lb. and 6*d. per* lb.	38	07	06
5 hogsheads sugar, containing 63 C. at 19*s. per* C.	59	17	00
Charges as *per* his invoice,	15	04	11
Balance in his hands, -	108	19	07

304 07 00

H. 5.

——22d.——

/ Settled accompts with *George Dennis*, and paid him in full, - - - 85 06 06

F. 4.

——June 27th.——

/ Paid Sir *Isaac Crisp* in full, - 40 00 00

F. 4.

——July 2d.——

/ Paid shop-rent for half a year, *viz.* from *January* 1. to *July* 1. - - 12 00 00

F. 12.

——5th——

/ Paid my shopkeeper his bill of postage, and other petty charges, - - - 2 12 08

F. 12.

——9th.——

/ Ship *Hopewell* is arrived safe with my goods from *Jamaica*; freight, duty, and other charges paid here, amount to - - 67 2 00

K. n. 2.

/ Sold *John Dyer* my six barrels indigo upon the key, at 4*s.* 3*d. per* lb.

	l.	*s*
Received in part, - -	80	13
Rest due at 6 months, - -	80	00

160 1[illegible] 00

K. n. 2.

——10th.——

/ Brought into my warehouse

	l.	*s.*	*d.*
My 5 hhds pymento, containing 1535 lb. valued at 6*d. per* lb.	38	07	0[illegible]
And also my 5 hhds sugar, containing 63 C. at 19*s. per* C.	59	17	[illegible]

98 0[illegible] 06

K. n. 2.

WASTE-BOOK. (6) *l. s. d.*

——July 15th.——

/ Drawn my bill on *William Boyd* in *Jamaica*, payable to *Edward Dupper*, or order, for value due by ditto *Dupper*, at 10 days, 108 [illegible] 07

L. 2.

——22d.——

J. P.
N° 1. 2. 3. / Shipped on board the *Dolphin*, consigned to *John Perkins* merchant in *Hamburg*, to sell for my account, the goods following, marked and numbered as *per* margin, *viz.*

	l.	*s.*	*d.*
My 5 hhds sugar, valued at -	59	17	0
18 pieces calicoes, bought of *Jacob Russel*, at 2*l.* 15*s.* to pay at 6 months,	49	10	0
8 fother lead, presently bought for ready money, at 12*l.* 18*s.*	103	04	0
Paid custom and other charges,	14	06	8

226 17 08

G. n. 1.

——30th.——

/ Received of *Edward Dupper*, in full for my bill on *William Boyd*, —— —— —— 108 1[illegible] 07

E. 4

——August 3d.——

/ Received of *Nathaniel Napier*, in part for druggets, —— —— —— 62 00 00

E. 4.

——6th.——

/ Lent *Edward Harley* upon bond, for three months, at 5 *per cent.* —— —— 400 00 00

F. 2.

——10th.——

/ Received from on board the *Griffin*, *John Temple* master, the following goods, to sell for account of *Herman Van Beek*, merchant in *Amsterdam*, *viz.* 18 C. flax, and 14 butts madder, each butt containing 12 C. ——
Paid custom, freight, wharfage, porterage, *&c.* —— —— —— —— 14 1[illegible] 05

M.

——17th.——

/ Sold *Herman Van Beek*'s 14 butts madder, containing 168 C. at 2*l.* 10*s. per* C. for ready money, —— —— —— 420 0[illegible] 00

N. 1.

——23d.——

/ Sold to *Thomas Freeman*, for account of *Herman Van Beek*, 18 C. flax at 3*l.* to pay at six M°. —— —— —— 54 [illegible] 00

N. 2.

/ Paid storage, brokerage, and other charges on *Herman Van Beek*'s goods, - - 1[illegible] [illegible] 06

N. 4.

/ My commission on 490*l.* at 2½ *per cent.* comes to - - - - - - - 12 05 00

N. 4.

(7) WASTE-BOOK.

		l.	s.	d.

——— August 30th. ———

HVB N°1. 2. By order of *Herman Van Beek*, I have shipped on board the *Weasle sloop*, *Thomas Dyke* master, bound for *Amsterdam*, the goods following, marked and numbered as *per* margin, *viz.*

	l.	s.	d
My 5hhds pymento, containing 1535 lb. which I value at 10*d. per* lb. - - -	63	19	2
12 hhds tobacco, presently bought for ready money, containing 60 C. at $2\frac{1}{2}$ *d. per* lb. -	62	10	0
Paid custom and other charges,	7	18	2
Due to *James Wright* for cooperage	0	12	8
My commission on the whole, at $2\frac{1}{2}$ *per cent.* - -	3	07	6

138 l. 07 s. 05 d.

O. n. 1. 3.

——— 31st. ———

	l.	s.	d
Paid *James Wright* in full for cooperage, - -	0	12	0
The abatement allowed by him is,	0	00	8

0 l. 12 s. 08 d.

N. n. 2. O. n. 3.

——— September 1st, ———

Our ship the *Britannia* is arrived from *Barbadoes*, and Mr *Steel* has paid the owners in full for freight. My $\frac{1}{4}$ part, which I have received, is - - - - - - — 72 l. 10 s. 00 d.

E. 10.

——— 3d. ———

Accepted *Herman Van Beek*'s bill on me, payable to *William Sabin* at six days sight; the sum is - - - - - — 200 l. 00 s. 00 d.

P. 2. F. n. 4. & 9.

——— 8th. ———

Remitted *Herman Van Beek* a bill of 584 guilders, drawn by *Joseph Buchan* on *Ralph Roger* merchant in *Amsterdam*, value paid here; exchange at 36*s*. 6*d*. is - - - — 53 l. 06 s. 08 d.

P. 4.

——— 10th. ———

Paid *William Sabin* in full for *Van Beek*'s bill — 200 l. 00 s. 00 d.

P. n. 1. F. n. 4. & 9.

Received of *Jacob Spence* 6 months interest of 1000*l.* lent him, the principal being continued in his hands for another half-year; the sum received is - - - - - — 25 l. 00 s. 00 d.

E. 7.

——— 22d. ———

Received advice from *John Perkins* of *Hamburgh*, That he hath received and disposed of my goods, the neat proceeds, as *per* accompt of sales, amounting to 405*l*. 5*s*. $1\frac{1}{2}$*d*. *Flemish*, exchange at 34*s*. 5*d*. makes *Sterling* — 235 l. 10 s. 00 d.

H. 2.

——— 28th. ———

Received from the commissioners of the customs the drawback on my 5 hhds sugar exported to *Hamburg*, - - - - — 8 l. 05 s. 04½ d.

G. n. 3.

WASTE-BOOK. (8)

——— September 30th. ———

John Perkins hath remitted me in full, exchange at 34*s*. in bills on the following persons, *viz.*

	l.	s.	d
One, on *John Alston*, for	80	00	0
One, on *Jacob Finch*, for	120	00	0
One, on *Stephen Morden*, for	38	07	$8\frac{1}{2}$

L. 5. — 238 l. 07 s. 08½ d.

——— October 4th. ———

Edward Hopkins and myself have agreed to go equal halves in 10 hhds tobacco, he to be manager; my half share, which I have paid him down, comes to - - - — 60 l. 00 s. 00 d.

Q. 1.

——— 9th. ———

Edward Hopkins having disposed of our tobacco, has paid me my proportion of neat proceeds, as follows, *viz.*

	l.	s.	d
Paid me in money - -	27	07	4
Given me a bill on *Richard Addison* for the rest -	45	00	0

R. 1. n. 1. — 72 l. 07 s. 04 d.

Delivered to *Edward Hopkins*, 40 pieces cambrics, to sell for our account, each $\frac{1}{2}$, valued at 3*l*. *per* piece, - - - — 120 l. 00 s. 00 d.

Q. 2.

——— 11th. ———

Received of *Edward Hopkins*, in full for his half-share of 40 pieces cambrics, - — 60 l. 00 s. 00 d.

Q. n. 2.

——— 20th. ———

Edward Hopkins has sold our cambrics for present money, and paid me my part of neat proceeds, as follows, *viz.*

	l.	s.	d.
Given me 72lb. cloves, at 9*s*.	32	08	00
The rest in money, -	30	00	00

62 l. 08 s. 00 d.

R. 1. n. 1.

——— 21st. ———

Bought of *James Ward* 90 pieces stuffs, at 2*l*. 8*s*. to pay at 3 months, - - — 216 l. 00 s. 00 d.

B. 3.

——— 22d. ———

Paid loss of a wager on a horse-race, — 2 l. 02 s. 00 d.

F. 14.

Bought in company with *George Kent*, each one half, the ship *Phœnix*, for which we have paid down our respective shares to the owners, amounting to - - - - - — 640 l. 00 s. 00 d.

S. 2. n. 2.

——— 25th. ———

The carpenter has brought in his bill of repairs on the *Phœnix*, which I have paid, — 16 l. 10 s. 00 d.

S. 3.

Mr *Jones* and company have freighted the *Phœnix*, for tear and wear of a voyage to *Cadiz*, at 22*l*. *per* month, and have thereupon advanced 1 month's freight, which I have received, - - - - — 22 l. 00 s. 00 d.

T. 1. n. 1.

(9) WASTE-BOOK.

		l.	s.	d.
	—— October 25th. ——			
/	The Royal Exchange inſurance-office has inſured to us 600 *l.* on the *Phœnix*, outward and inward at 3 *per cent.* the premium, which I have paid, comes to, - - - S. 3.	18	00	00
	—— 26th. ——			
/	Bought of *Richard Owen*, for account of *George Kent* and myſelf in company, each ½, 4 pipes ſherry, at 26 *l.* - 104 *l.* 00 *s.* 5 pipes ditto, at 26 *l.* 10 *s.* 132 *l.* 10 *s.* Due on demand, S. 1.	236	10	00
	—— 27th. ——			
/	Adjuſted accounts with *George Kent*, and received His half-ſhare of my diſburſements on the *Phœnix*, 6 *l.* 5 *s.* 0 *d.* Received alſo his half-ſhare of the price of 9 pipes ſherry, 118 *l.* 5 *s.* 0 *d.* U. 1.	124	10	00
/	Paid *Richard Owen*, in full for ſherry S. 1. n.	236	10	00
	—— 29th. ——			
	Sold *Edward Turner* our 5 beſt pipes ſherry, at 29 *l.* Received in part, - - 120 *l.* 00 *s.* Reſt due on demand, - 25 *l.* 00 *s.* T. 1.	145	00	00
	—— November 1ſt. ——			
/	Sold our other 4 pipes ſherry, for ready money, at 27 *l.* 12 *s.* - - - T. 1.	110	08	00
	Received of *Edward Turner*, in full for our ſherry, - - - - T. 1. n. 2.	25	00	00
	Paid carriage, cellar-rent, and other charges on our ſherry, - - - - S. 3. T. 3. n. 2.	3	02	00
/	My commiſſion on the whole, at 1½ *per cent.* amounts to - - - - T. 3. n. 2.	7	08	06
	—— 4th. ——			
/	Paid *George Kent*, in full for his half-ſhare of neat proceeds on ſherry, - - U. 4.	122	08	09
	—— 8th. ——			
/	Received from *Edward Harley*, in full of his bond dated 6th *Auguſt* laſt, with 3 months intereſt at 5 *per cent.* The principal is - - 400 *l.* 00 *s.* The intereſt comes to - - 5 *l.* 00 *s.* E. 8.	405	00	00

WASTE-BOOK. (10)

		l.	s.	d.
	—— November 11th. ——			
/	Paid one year's rent of my dwelling-houſe, *viz.* from *Mart.* 1764 to *Mart.* 1765, F. 13.	40	00	00
	—— 12th, ——			
/	*George Evans* is broke, and I have compounded his debt of 300 *l.* at 12 *s.* *per* pound. The compoſition received is 180 *l.* 00 *s.* The diſcount is - - 120 *l.* 00 *s.* E. 5.	300	00	00
/	Received of *Nathaniel Niaper*, in full for druggets, - - — E. 4.	62	00	00
	—— 15th. ——			
P. J. Nº 1. 2. 3. /	*Simon King*, *John Oker*, and myſelf, reſolving to make an equal joint adventure, we have put into company what goods each of us have proper for the intended voyage, without regard to our due proportions, purpoſing to adjuſt that matter with money. *Simon King*, 80 pieces ſerge, at 5 *l.* 10 *s.* - - 440 *l.* 00 *s.* *John Oker*, 70 pieces frize, at 4 *l.* 280 *l.* 00 *s.* I have put in my 90 pieces ſtuffs, which I value at 2 *l.* 10 *s.* 225 *l.* 00 *s.* I have paid charges till on board, 27 *l.* 10 *s.* I have alſo paid *Simon Smith* and comp. for inſuring 900 *l.* on our ſaid adventure, - 22 *l.* 10 *s.*	995	00	00
	Shipped the whole on board the *Thiſtle*, Capt. *Bently* maſter, conſigned to *Philip Jenkins* merchant in *Lisbon*, to ſell for our account, being marked and numbered as *per* margin. V. 2. n. 2.			
	—— 17th. ——			
/	Upon adjuſting accompts with *Simon King* and *John Oker*, there appears due to the former, From *John Oker*, - - 51 *l.* 13 *s.* 4 *d.* And from me - - - 56 *l.* 13 *s.* 4 *d.* Which we have paid, the total being U. 4. & 7.	108	06	08
	—— 22d. ——			
/	*Simon King*, *John Oker*, and myſelf, reſolving further to trade in company, have bought of *George Wood* 18 tuns oil of *Gallipoly*, at 29 *l.* 10 *s.* due on demand, S. 1.	531	00	00
	—— 25th. ——			
/	*Simon King*, *John Oker*, and myſelf, have paid *George Wood*, in full for oil, as follows, *viz.* *S. King* has given him goods to the value of - 120 *l.* 0 *s.* *John Oker* has counted with him for 200 *l.* 0 *s.* I have paid him the reſt in money, 211 *l.* 0 *s.* U. 8. S. 1. n.	531	00	00

Simon

(11) WASTE-BOOK.

		l.	s.	d.
	November 21st.			
/	*Simon King* has evened our accompts, by paying — l. s. To *John Oker*, - - 23 0 And to me, - - 34 0 U. 7. & 1.	57	00	00
	30th.			
/	Sold *James Fuller*, 1 tun of our oil, to pay at 14 days. - - - T. 1.	30	00	00
	December 2d.			
/	Sold *George Young*, 7 tuns of our oil, at 30 *l.* 10 *s.* — *l.* *s.* Received in part, - - 113 10 Rest due in 10 days, - - 100 00 T. 1.	213	10	00
	7th.			
/	Bartered 10 tuns of our oil, at 32 *l.* for 12 pipes Canary wine, of the same value, *viz.* — *l.* *s.* 6 pipes at 28 *l.* 6 *s.* 8 *d.* - 170 0 And 6 pipes at 25 *l.* - - 150 0 T. 2.	320	00	00
	13th.			
/	Received of *George Young*, in full for oil, T. 1. n. 2	100	00	00

WASTE-BOOK. (12)

		l.	s.	d.
	December 18th.			
/	Sold our 6 pipes best Canary, for present money, at 29 *l.* 12. *s.* - - T. 1.	177	12	00
	20th.			
/	*James Fuller* is broke, and we have compounded his debt of 30 *l.* at 8 *s.* *per* pound, — *l.* *s.* The composition which I have received is - - - 12 0 The discount amounts to - 18 0 T. 1. n. 2.	30	00	00
	24th.			
/	*Simon King*, *John Oker*, and myself, have parted the remaining 6 pipes Canary equally among ourselves; which, valued at 25 *l.* *per* pipe, comes to - - - T. 3.	150	00	00
	27th.			
/	The *Phœnix* is arrived from *Cadiz*, and Mr *Jones* has paid me, in full for freight, T. 1. n. 1.	22	00	00
	28th.			
/	Sold our *Phœnix* to Mr *Jones* and company, to pay at 3 months, - - T. 1.	700	00	00
	30th.			
/	Laid out for the use of my family, since the 1st of January last, - - F. 13.	200	00	00

1

JOURNAL.

Edinburgh, the 1st of *January* 1769.

			l.	s.	d.
	Sundries Drs to *Stock*, 13407 *l.*	l. s. d.			
.1	*Cash*, for ready money,	12000 00 0			
.1	*Linen*, for 2000 yards, at 2 *s.* 6 *d.*	250 00 0			
.1	*Indian chints*, for 15 pieces, at 24 *l.* 10 *s.*	367 10 0			
.1	*Ship Britannia*, for ¼ cost,	348 10 0			
.2	*John Harris*, *per* note on demand,	45 00 0			
.2	*Thomas Freeman*, *per* bill due *Feb.* 2.	96 00 0			
.2	*George Evans*, *per* bond at 5 *per cent.*	300 00 0			
.2			13407	00	00
.2	*Stock* Dr to *Sundries*, 156 *l.*	l. s. d.			
.2	To *Joseph Martin*, on demand,	36 00 0			
.2	To Sir *Isaac Crisp*, due 1st of *June*,	120 00 0			
			156	00	00
	6th.				
2	*Cambrics* Dr to *Cash*, 112 *l.*				
.1	Paid for 40 pieces, at 2 *l.* 16 *s.*		112	00	00
	10th.				
.2	*Duroys* Dr to *John Vernon*, 130 *l.*				
.3	Bought 100 pieces, at 26 *s.* to pay at 2 months,		130	00	00
	15th.				
.2	*Joseph Martin* Dr to *Cash*, 36 *l.*				
.1	Paid him in full,		36	00	00
.3	*Druggets* Dr to *Sundries*, 195 *l.*	l. s.			
.1	To *Cash*, in part for 26 pieces, at 7 *l.* 10 *s.*	97 10			
.3	To *Jacob Russel*, for the rest, on demand,	97 10			
			195	00	00
	21st.				
.3	*Voyage to Jamaica* Dr to *Sundries*, 223 *l.* 11 *s.* 4 *d.*	l. s. d.			
.2	To *Duroys*, for 70 pieces, at 26 *s.*	91 00 0			
.3	To *Jacob Green*, for 6 pieces holland, at 18 *l.* to pay at 2 months.	108 00 0			
.1	To *Cash*, paid charges and premium,	24 11 4			
			223	11	04
	30th.				
.3	*Jacob Russel* Dr to *Cash*, 97 *l.* 10 *s.*				
.1	Paid him in full for druggets,		97	10	00

JOURNAL. (2)

			l.	s.	d.
	February 2d.				
.3	*Broad Cloth* Dr to *Sundries*, 675 *l.*	l. s.			
.1	To *Cash*, in part, for 1000 yards, at 13 *s.* 6 *d.*	330 0			
.2	To *John Harris*, for my bill on him,	45 0			
.3	To *Edward Harley*, for the rest at 3 months,	300 0			
			675	00	00
	5th.				
.1	*Cash* Dr to *Thomas Freeman*, 96 *l.*				
.2	Received of him in full,		96	00	00
	16th.				
	Sundries Drs to *Cash*, 765 *l.*	l. s.			
.3	*Kerseys*, for 90 pieces, at 6 *l.*	540 0			
.3	*Fustians*, for 120 pieces, at 37 *s.* 6 *d.*	225 0			
.1			765	00	00
	25th.				
.1	*Cash* Dr to *Druggets*, 81 *l.* 10 *s.*				
.3	Received for 10 pieces, at 8 *l.* 3 *s.*		81	10	00
	March 1st.				
.4	*George Young* Dr to *Broad Cloth*, 280 *l.*				
.3	Sold him 400 yards, at 14 *s.* to pay at 1 M°,		280	00	00
	4th.				
	Sundries Drs to *Kerseys*, 571 *l.* 10 *s.*	l. s.			
.1	*Cash*, in part for 90 pieces, at 6 *l.* 7 *s.*	300 00			
.4	*John Keil*, for the rest, at 20 days,	271 10			
.3			571	10	00
	10th.				
.3	*John Vernon* Dr to *Cash*, 130 *l.*				
.1	Paid him in full for *duroys*,		130	00	00
.4	*Jacob Spencer* Dr to *Cash*, 1000 *l.*				
.1	Lent him upon bond for 6 months, at 5 *per cent. per ann.*		1000	00	00
	17th.				
.4	*Bills receivable* Dr to *Broad Cloth*, 141 *l.* 13 *s.* 4 *d.*				
.3	Sold *Jacob Preston* 200 yards, at 14 *s.* 2 *d.* and received his bill on *Henry Sidney* for the whole, payable at sight,		141	13	04
	22d.				
	Sundries Drs to *Broad Cloth*, 285 *l.* 16 *s.* 8 *d.*	l. s. d.			
.4	*Foreign Coin*, for 26 moidores, at 27 *s.* in part for 400 yds, at 14 *s.* 3½ *d.*	35 02 0			
.1	*Cash*, in *British* money,	150 14 8			
.4	*Bills receivable*, for *Richard Stone*'s assignment on *George Digby*, for the rest,	100 00 0			
.3			285	16	08
	23d.				
.3	*Jacob Green* Dr to *Sundries*, 108 *l.*	l. s.			
.4	To *Foreign Coin*, for 26 moidores, at 26 *s.* 6 *d.*	34 09			
.1	To *Cash*, for *British* money,	73 11			
			108	00	00
	Paid him in full for holland.				

March

(3) JOURNAL.

		l.	s.	d.
	—— March 23d. ——			
.1 / .4	*Cash* Dr to *Bills receivable*, 141 *l.* 13 *s.* 4 *d.* Received of *Henry Sidney*, in full of *Jacob Preston*'s bill, - - - -	141	13	04
	—— April 1st. ——			
	Sundries Drs to *John Keil*, 271 *l.* 10 *s.* *l.* *s.*			
.1	*Cash*, in full for kersey, - - 270 00			
.3	*Kerseys*, abated him, - - 1 10			
.4		271	00	00
	—— 6th. ——			
.1 / .4	*Cash* Dr to *George Young*, 280 *l.* Received of him in full for broad cloth,	280	10	00
	—— 10th. ——			
.4 / .1	*Lockrams* Dr to *Indian Chints*, 50 *l.* Received 40 pieces, at 25 *s.* in barter, for 2 pieces, at 25 *l.* - - -	50	00	08
	—— 16th. ——			
	Sundries Drs to *Linen*, 133 *l.* 6 *s.* 8 *d.* *l.* *s.* *d.*			
.4	*Cochineal*, for 1 C. valued at 108 16 0			
.4	*Cinnamon*, for 64 lb. at 7 *s.* 8 *d.* 24 10 8			
.1		133	06	00
	Received in barter for 1000 yards, at 2 *s.* 8 *d.*			
	—— 22d. ——			
	Sundries Drs to *Indian Chints*, 148 *l.* 10 *s.* *l.* *s.*			
.5	*Muslin*, for 8 bales, at 12 *l.* 16 *s.* 102 8			
.1	*Cash*, for the balance paid me, 46 2			
.1		148	00	00
	Received in barter for 6 pieces, at 24 *l.* 15 *s.*			
	—— 30th. ——			
.5	*George Dennis* Dr to *Sundries*, 187 *l.* 10 *s.* *l.* *s.*			
.1	To *Linen*, for 100 yards, at 2 *s.* 9 *d.* 137 10			
.1	To *Indian Chints*, for 2 pieces, at 25 *l.* 50 00	187	10	00
	Delivered him in barter.			
	Sundries Drs to *George Dennis*, 164 16 *s.* 6 *d.* *l.* *s.* *d.*			
.5	*Cotton*, for 17 bags, containing 42 C. 2 Q. neat, at 3 *l.* 15 *s.* *per* C. - - } 159 07 6			
.5	*Cloves*, for 12 lb. at 9 *s.* 1 *d.* 5 09 0			
.5		164	16	06
	Received of him in barter.			
	—— May 3d. ——			
.3 / .1	*Edward Harley* Dr to *Cash*, 300 *l.* Paid him in full for broad cloth, -	300	00	00
	—— 7th. ——			
.5 / .3	*Suspense-accompt* Dr to *Druggets*, 124 *l.* Sent *Nathaniel Napier* 16 pieces, desiring him to take them at 7 *l.* 15 *s.* or return them,	124	00	00
	—— 13th. ——			
.5 / .1	*Refusal of Bargains* Dr to *Cash*, 2 *l.* 2 *s.* Paid to *Simon Smart*, as a penalty for refusing a bargain of *Norwich* stuffs, - -	2	02	00

JOURNAL. (4)

		l.	s.	d.
	—— May 18th. ——			
.5	*John Jessop his accompt-current* Dr to *Sundries*, 360 *l.* 15 *s.* *l.* *s.*			
.5	To *George Dennis*, for 8 tuns lead, at 13 *l.* 10 *s.* to pay at 1 month, } 108 0			
.1	To *Cash*, for 7536 lb. tanned leather, at 7 *d.* with custom, insurance, *&c.* } 241 5			
.5	To *George Aiton*, for packing, 1 5			
.6	To *Profit and Loss*, for my commission, 10 5	360	15	00
	—— 22d. ——			
.5 / .1	*George Aiton* Dr to *Cash*, 1 *l.* 5 *s.* Paid him in full for packing *John Jessop*'s leather, - - -	1	05	00
	—— 31st. ——			
.1 / .5	*Cash* Dr to *John Jessop his accompt current*, 200 *l.* Drawn my bill on him, for 960 dollars, at 50 *d.* payable to *George Stapleton*, or order, value received, - - - -	200	00	00
	—— June 3d. ——			
.3 / .6	*John Vernon* Dr to *Profit and Loss*, 200 *l.* Left me in legacy by Dr *George Friend*, and payable by ditto *Vernon*, his executor, -	200	00	00
	—— 8th. ——			
.2 / .1	Sir *Isaac Crisp* Dr to *Cash*, 80 *l.* Paid him in part, - -	80	00	00
	—— 16th. ——			
.6 / .5	*Nathaniel Napier* Dr to *Suspense accompt*, 124 *l.* Writes me, that he keeps the 16 pieces druggets sent him the 7th of *May* last, promising to pay one half against the 1st of *August*, and the other half at *Martinmas*, the whole being,	124	00	00
	—— 18th. ——			
	Sundries Drs to *Voyage to Jamaica*, 304 *l.* 7 *s.* *l.* *s.* *d.*			
.6	*Voyage from Jamaica*, for goods returned, and charges, } 195 07 5			
.6	*William Boyd my accompt current*, for balance in his hands, } 108 19 7			
.3		30[illegible]	[illegible]7	00
	—— 22d. ——			
.5 / .1	*George Dennis* Dr to *Cash*, 85 *l.* 6 *s.* 6 *d.* Paid him in full - - -	85	06	06
	—— 29th. ——			
.2 / .1	Sir *Isaac Crisp* Dr to *Cash*, 40 *l.* Paid him in full - - - -	40	00	00
	—— July 2d ——			
.7 / .1	*Charges of merchandize* Dr to *Cash*, 12 *l.* Paid shop-rent for ½ year, *viz.* from *January* 1. to *July* 1. - - -	12	00	00
	—— 5th. ——			
.7 / .1	*Charges of merchandize* Dr to *Cash*, 2 *l.* 12 *s.* 8 *d.* Paid my shop-keeper his bill of postage, and other charges, - - -	2	12	08
	—— 9th. ——			
.6 / .1	*Voyage from Jamaica* Dr to Cash, 97 *l.* 12 *s.* Paid freight, duty, and other charges here,	97	12	00
	Sundries Drs to *Voyage from Jamaica*, 160 *l.* 13 *s.* *l.* *s.*			
.1	*Cash* in part for 6 barrels indigo, containing 756 lb. at 4 *s.* 3 *d.* per lb. } 80 13			
.7	*John Dyer*, for the rest at six months, 80 00			
.6		160	13	00

(5) JOURNAL.

			l.	s.	d.
	July 10th.				
.7	*Sundries* Drs to *Voyage from Jamaica*, 98 *l.* 4 *s.* 6 *d.*	*l. s. d.*			
.7	*Pymento*, for 5 hogsheads, containing 1535 lb. at 6 *d. per* lb.	38 07 6			
.7 / .6	*Sugar*, for 5 hogsheads, containing 63 C. at 19 *s. per* C.	59 17 0			
	Brought into my warehouse.		98	04	06
	15th.				
.7 / .6	*Edward Dupper* Dr to *William Boyd my accompt-current*, 108 *l.* 19 *s.* 7 *d.* Drawn my bill on him, payable to ditto *Dupper*, value due by him, at 10 days,		108	19	07
	22d.				
.7	*Voyage to Hamburg* Dr to *Sundries*, 226 *l.* 17 *s.* 8 *d.*	*l. s. d.*			
.7	To *Sugar*, for 5 hogsheads, valued at	59 17 0			
.3	To *Jacob Russel*, for 18 pieces callicoes, at 2 *l.* 15 *s.* to pay at 6 months,	49 10 0			
.1	To *Cash*, for 8 fother lead, at 12 *l.* 18 *s.* and charges at shipping,	117 10 8			
			226	17	08
	30th.				
.1 / .7	*Cash* Dr to *Edward Dupper*, 108 *l.* 19 *s.* 7 *d.* Received of him, in full of my bill on *William Boyd*,		108	19	07
	August 3d.				
.1 / .6	*Cash* Dr to *Nathaniel Napier*, 62 *l.* Received his first moiety for druggets,		62	00	00
	6th.				
.3 / .1	*Edward Harley* Dr to *Cash*, 400 *l.* Lent him upon bond, for 3 months, at 5 *per cent.*		400	00	00
	10th.				
.7 / .1	*Herman Van Beek his accompt of goods*, Dr to *Cash*, 14 *l.* 12 *s.* 6 *d.* Paid custom, freight, and other charges on them,		14	12	06
	17th.				
.1 / .7	*Cash* Dr to *Herman Van Beek his accompt of goods*, 420 *l.* Received for his 14 butts madder, containing 168 C. at 2 *l.* 10 *s. per* C.		420	00	00
	23d.				
.2 / .7	*Thomas Freeman* Dr to *Herman Van Beek his accompt of goods*, 54 *l.* For his 18 C. flax, at 3 *l.* to pay at 6 months,		54	00	00
.7 / .1	*Herman Van Beek his accompt of goods* Dr to *Cash*, 1 *l.* 7 *s.* 6 *d.* Paid storage, brokerage, *&c.*		1	07	06
.7 / .6	*Herman Van Beek his accompt of goods* Dr to *Profit and Loss*, 12 *l.* 5 *s.* For my commission at 2½ *per cent.*		12	05	00

JOURNAL. (6)

			l.	s.	d.
	August 30th.				
.7	*Herman Van Beek his accompt current* Dr to *Sundries*, 138 *l.* 7 *s.* 6 *d.*	*l. s. d.*			
.7	To *Pymento*, for 5 hogsheads, containing 1535 lb. which I value at 10 *d. per* lb.	63 19 2			
.1	To *Cash*, for 12 hogsheads tobacco, containing 60 C. at 2½ *d. per* lb. and charges,	70 08 2			
.8	To *James Wright*, for cooperage,	0 12 8			
.6	To *Profit and Loss*, for my commission at 2½ *per cent.*	3 07 6			
			138	07	06
	31st.				
.8	*James Wright* Dr to *Sundries*, 12 *s.* 8 *d.*	*s. d*			
.1	To *Cash*, in full,	12 0			
.7	To *H. Van Beek his accompt-current*, abated,	00 8			
			0	12	08
	September 1st.				
.1 / .1	*Cash* Dr to *Ship Britannia*, 72 *l.* 10 *s.* Received my ¼ of freight from Mr *Steel*,		72	10	00
	3d.				
.7 / .8	*Herman Van Beek his accompt-current* Dr to *Bills payable*, 200 *l*, Accepted his bill on me payable to *William Sabin* at 6 days,		200	00	00
	8th.				
.7 / .1	*Herman Van Beek his accompt-current* Dr to *Cash*, 53 *l.* 6 *s.* 8 *d.* Remitted him 584 guilders in *Joseph Buchan*'s bill on *Ralph Roger*, value paid here,		53	06	08
	10th.				
.8 / .1	*Bills payable* Dr to *Cash*, 200 *l.* Paid *William Sabin*, in full of *Van Beek*'s bill on me,		200	00	00
.1 / .6	*Cash* Dr to *Profit and Loss*, 25 *l.* Received 6 months interest of 1000 *l.* lent *Jacob Spencer*,		25	00	00
	22d.				
.8 / .7	*John Perkins my accompt current* Dr to *Voyage to Hamburg*, 235 *l.* 10 *s.* Received advice that he hath sold my goods, the neat proceeds amounting to 405 *l.* 5 *s.* 1½ *d. Flemish*, exchange at 34 *s.* 5 *d.* makes *Sterling*,		235	10	00
	28th.				
.1 / .7	*Cash* Dr to *Voyage to Hamburg*, 8 *l.* 5 *s.* 4½ *d.* Received drawback on my 5 hogsheads sugar exported,		8	05	04½
	30th.				
.4 / .8	*Bills receivable* Dr to *John Perkins my accompt-current*, 238 *l.* 7 *s.* 8½ *d.* Remitted to me in full of 405 *l.* 5 *s.* 1½ *d.* exchange at 34 *s.* in bills, *viz.*	*l. s. d.*			
	One, on *John Alston*, for	80 00 0			
	One, on *Jacob Finch*, for	120 00 0			
	One, on *Stephen Morden*, for	38 07 8½			
			238	07	08½

October

		l.	d	s.
	October 4th.			
.8 .1	*Edward Hopkins my accompt in company* Dr to *Cash*, 60 *l.* Paid him my half share of 10 hogsheads tobacco in his hands, - - -	60	00	00
	9th.			
	Sundries Drs to *Edward Hopkins my accompt in company*, 72 *l.* 7 *s.* 4 *d.*			
	l. s. d.			
.1	*Cash*, received in money, - 27 07 4			
.4 .8	*Bills receivable*, for one on *R. Addison*, - - 45 00 0	72	07	04
	Sundries Drs to *Cambrics*, 120 *l.*			
	l. s.			
.8	*Edward Hopkins my accompt in company*, for my half share of 40 pieces, at 3 *l.* - - 60 00			
.8 .2	*Edward Hopkins my accompt proper*, for his half share, 60 00	120	00	00
	11th.			
.1 .8	*Cash* Dr to *Edward Hopkins my accompt proper*, 60 *l.* Received for his half share of cambrics,	60	00	00
	20th.			
	Sundries Drs to *Edward Hopkins my accompt in company*, 62 *l.* 8 *s.*			
	l. s.			
.5	*Cloves*, for 72 lb. at 9 *s.* - 32 8			
.1 .8	*Cash*, received in money, - - 30 0	62	08	00
	21st.			
.8 .8	*Stuffs* Dr to *James Ward*, 216 *l.* Bought 90 pieces, at 2 *l.* 8 *s.* to pay at 3 months, - - - -	216	00	00
	22d.			
.6 .1	*Profit and Loss* Dr to *Cash*, 2 *l.* 2 *s.* Paid loss of a wager on a horse-race, -	2	02	00
.8 —	*Ship Phœnix in company with George Kent* Dr to *Sundries*, 640 *l.* *l. s.*			
.1	To *cash*, for my half share, - 320 0			
.8	To *George Kent his accompt in company*, for his half share, 320 0	640	00	00
	25th.			
.8 — .1	*Ship Phœnix in company with George Kent* Dr to *Cash*, 16 *l.* 10 *s.* Paid the carpenter his bill of repairs, -	16	10	00
.9 — .8	*George Kent his accompt proper* Dr to *ditto Kent his accompt in company*, 8 *l.* 5 *s.* For his half share of repairs, - -	8	05	00
.1 — .8	*Cash* Dr *to Ship Phœnix in Company with George Kent*, 22 *l.* Received 1 month's freight, - -	22	00	00
.8 — .9	*George Kent his accompt in company* Dr to *ditto his accompt proper*, 11 *l.* For his half share of 1 month's freight received, - - - -	11	00	00

		l.	s.	d.
	October 25th.			
.8 .9	*Ship Phœnix in company with George Kent* Dr to *Cash*, 18 *l.* Paid premium for insuring 600 *l.* to and from *Cadiz*, - - - -	18	00	00
.9 .8	*George Kent his accompt proper* Dr to *ditto his accompt in company*, 9 *l.* For his half share of premium, -	9	00	00
	26th.			
.9 .9	*Sherry in company with George Kent* Dr to *Richard Owen*, 236 *l.* 10 *s.* For 9 pipes, *viz.* 4 at 26 *l.* and 5 at 26 *l.* 10 *s.* due on demand, - - -	236	10	00
.9 .8	*George Kent his accompt proper* Dr to *ditto his accompt in company*, 118 *l.* 5 *s.* For his half share of 9 pipes sherry, -	118	05	00
	27th.			
.9 .9	*Cash* Dr to *George Kent his accompt proper*, 124 *l.* 10 *s.* Received of him his half share of my disbursements on the *Phœnix*, and also his half share of the price of 9 pipes sherry, - -	124	10	00
.9 .9	*Richard Owen* Dr to *Cash*, 236 *l.* 10 *s.* Paid him in full for sherry, - -	236	10	00
	29th.			
	Sundries Drs to *Sherry in Company with George Kent*, 145 *l.*			
	l. s.			
.9	*Cash*, in part for our 5 best pipes, at 29 *l.* - - 120 00			
.9 .9	*Edward Turner*, for the rest, on demand, - - 25 00	145	00	00
.8 .9	*George Kent his accompt in company* Dr to *ditto his accompt proper*, 72 *l.* 10 *s.* For his half share of 5 pipes sherry sold *Edward Turner*, at 29 *l.* -	72	10	00
	November 1st.			
.9 — .9	*Cash* Dr to *Sherry in company with George Kent*, 110 *l.* 8 *s.* Received for 4 pipes, at 27 *l.* 12 *s.* -	110	08	00
.8 — .9	*George Kent his accompt in company* Dr to *ditto his accompt proper*, 55 *l.* 4 *s.* For his half share of 110 *l.* 8 *s.* received for 4 pipes sherry, - - -	55	04	00
.9 .9	*Cash*, Dr to *Edward Turner*, 25 *l.* Received of him in full for sherry, -	25	00	00
.9 — .9	*Sherry in company with George Kent* Dr to *Cash*, 3 *l.* 2 *s.* Paid carriage, cellar-rent, *&c.* -	3	02	00
.9 .8	*George Kent his accompt proper* Dr to *ditto his accompt in company*, 1 *l.* 11 *s.* For his half share of carriage, cellar-rent, *&c.*	1	11	00

November

(9) JOURNAL.

			l.	s.	d.
	November 1st.				
.9 / .6	*Sherry in company with George Kent* Dr to *Profit and Loss*, 7 *l.* 8 *s.* 6 *d.* For my commission, at 1½ *per cent.*		7	08	06
.9 / .8	*George Kent his accompt proper* Dr to *ditto his accompt in company*, 3 *l.* 14 *s.* 3 *d.* For his half share of my commission,		3	14	03
	4th.				
.9 / .9	*George Kent his accompt proper* Dr to *Cash*, 122 *l.* 8 *s.* 9 *d.* Paid him in full for his half share of neat proceeds on sherry,		122	[illegible]	[illegible]
	8th.				
.9	*Cash* Dr to *Sundries*, 405 *l.*	*l.* *s*			
.3	To *Edward Harley*, for principal lent him the 6th of *August* last,	400 00			
.6	To *Profit and Loss*, for 3 months interest, at 5 *per cent.*	5 00	405	00	00
	11th.				
.9 / .9	*House expences* Dr to *Cash*, 40 *l.* Paid one year's rent of my dwelling-house,		40	00	00
	12th.				
	Sundries Drs to *George Evans*, 300 *l.*	*l.* *s.*			
.9	*Cash*, received in composition of his debt,	180 0			
.6	*Profit and Loss*, abated him,	120 0	300	00	00
.2					
.9 / .6	*Cash* Dr to *Nathaniel Napier*, 62 *l.* Received of him in full,		62	00	00
	15th.				
.9	*Voyage to Lisbon in company with Simon King and John Oker* Dr to *Sundries*, 995 *l.*	*l.* *s.*			
.10	To *Simon King his accompt proper*, for 80 pieces serge, at 5 *l.* 10 *s.*	440 00			
.10	To *John Oker his accompt proper*, for 70 pieces frize, at 4 *l.*	280 00			
.8	To *Stuffs*, for 90 pieces, at 2 *l.* 10 *s.*	225 00			
.9	To *Cash*, for charges and premium,	50 00	995	00	00
.10 / .10	*Simon King his accompt proper* Dr to *ditto his accompt in company*, 331 *l.* 13 *s.* 4 *d.* For his ⅓ share of the voyage to *Lisbon*,		331	13	04
.10 / .10	*John Oker*, ditto,		331	13	04
	17th.				
.10	*Simon King his accompt proper* Dr to *Sundries*, 108 *l.* 6 *s.* 8 *d.*	*l.* *s.* *d.*			
.10	To *J. Oker his accompt proper* paid by him,	51 13 4			
.9	To *Cash*, paid by me,	56 13 4	108	06	08

JOURNAL. (10)

			l.	s.	d.
.10	November 22d.				
.10	*Oil in company with Simon King and John Oker* Dr to *George Wood*, 531 *l.* Bought 18 tuns, at 29 *l.* 10 *s.* due on demand,		531	00	00
.10 / .10	*Simon King his accoompt proper* Dr to *ditto his accompt in company*, 177 *l.* For his ⅓ share of 18 tuns oil,		177	00	00
.10 / .10	*John Oker*, ditto,		177	00	00
	25th.				
.10	*George Wood* Dr to *Sundries*, 531 *l.*	*l.* *s.*			
.10	To *Simon King his accompt proper*, paid by him,	120 00			
.10	To *John Oker his accompt proper*, paid by him,	200 00			
.9	To *Cash*, paid by me,	211 00	531	00	00
	Sundries Drs to *S. King his accompt proper*, 57 *l.*	*l.* *s.*			
.10	*John Oker his accompt proper*, paid to him,	23 00			
.9	*Cash*, paid to me,	34 00	57	00	00
.10					
	30th.				
.10 / .10	*James Fuller* Dr to *Oil in company with S. King and J. Oker*, 30 *l.* Sold him 1 tun, to pay at 14 days,		30	00	00
.10 / .10	*Simon King his accompt in company* Dr. to *ditto his accompt proper*, 10 *l.* For his ⅓ share,		10	00	00
.10 / .10	*John Oker*, ditto,		10	00	00
	December 2d.				
	Sundries Drs to *Oil in company with S. King and J. Oker*, 213 *l.* 10 *s.*	*l.* *s.*			
.9	*Cash*, in part for 7 tuns, at 30 *l.* 10 *s.*	113 10			
.4	*George Young*, for the rest, at 10 days,	100 00	213	10	00
.10					
.10 / .10	*Simon King his accompt in company* Dr to *ditto his accompt proper*, 71 *l.* 3 *s.* 4 *d.* For his ⅓ share of seven tuns of oil sold,		71	03	04
.10 / .10	*John Oker*, ditto,		71	03	04
	7th.				
.10 / .11	*Canary in company with S. King and J. Oker* Dr to *Oil in company with ditto*, 320 *l.* Received 12 pipes, *viz.* 6 pipes at 28 *l.* 6 *s.* 8 *d.* and 6 pipes at 25 *l.* in barter for 10 tuns, at 32 *l.*		320		00
	13th.				
.9 / .4	*Cash* Dr to *George Young*, 100 *l.* Received of him, in full for oil in company,		100	00	00

December

(11) JOURNAL.

Fol.	Entry	l.	s.	d.
	December 18th.			
.9 / .11	*Cash* Dr to *Canary in company with Simon King and John Oker*, 177 *l.* 12 *s.* Received for 6 pipes, at 29 *l.* 12 *s.*	177	12	00
.10 / .10	*Simon King his accompt in company* Dr to *ditto his accompt-proper*, 59 *l.* 4 *s.* For his $\frac{1}{3}$ share of 177 *l.* 12 *s.* received for Canary, - - - -	59	04	00
.10 / .10	*John Oker*, ditto, - - -	59	04	00
	20th.			
	Sundries Drs to *James Fuller*, 30 *l.*			
.9	*Cash*, received in composition of his debt, - - } 12 *l.* 00 *s.*			
.10	*Oil in company with S. King and John Oker*, abated him, } 18 *l.* 00 *s.*	30	00	00
.10 / .10	*Simon King his accompt-proper* Dr to *ditto his accompt in company*, 6 *l.* For his $\frac{1}{3}$ share of 18 *l.* abated -	6	00	00
.10 / .10	*John Oker*, ditto, - - -	6	00	00
	24th.			
	Sundries Drs to *Canary in company with S. King and J. Oker*, 150 *l.*			
.10	*S. King his accompt in company*, for 2 pipes taken to himself, as his share of what remains, } 50 *l.* 00 *s.*			
.10 / .11	*J. Oker his accompt in company*, for *ditto*, - - } 50 *l.* 00 *s.*			
.11	*Canary*, for 2 pipes retained, as my share, - - } 50 *l.* 00 *s.*	150	00	00

JOURNAL. (12)

Fol.	Entry	l.	s.	d.
	December 27th.			
.9 / .8	*Cash* Dr to *Ship Phœnix in company with George Kent*, 22 *l.* Received in full for freight, - -	22	00	00
.8 / .9	*George Kent his accompt in company* Dr to *ditto his accompt-proper*, 11 *l.* For his half share of 22 *l.* received as freight,	11	00	00
	28th.			
.11 / .8	*Mr Jones and company* Dr to *Ship Phœnix in company with George Kent*, 700 *l.* Sold *ditto* ship, to pay at 3 months, -	700	00	00
.8 / .9	*George Kent his accompt in company* Dr to *ditto his accompt proper*, 350 *l.* For his half share, - - -	350	00	00
	30th.			
.9 / .9	*House-expences* Dr to *Cash*, 200 *l.* Expended since the 1st of *January* last,	200	00	00

LEDGER, 1769.

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		Boyd (William) my acct-curt	6	Criſp (Sir Iſaac)	2	Dennis (George)	5			Foreign coin	4
		Bills payable	8	Cambrics	2	Dyer (John)	7			Fuller (James)	10
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				Cotton	5						
				Cloves	5						
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		Harley (Edward)	3	Jones (Mr) and company	11	Keil (John)	4	Lockrams	4	Muſlin	5
		Hopkins (Edw.) my accompt in comp.	8			Kent (George) his accompt in comp.	8				
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						King (Simon) his accompt in comp.	10				

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		Oker (John) his acct proper	10	Pymento	7			Refuſal of bargains	5	Stock	2
		Oker (John) his acct in comp.	10	Perkins (John) my acct-curt	7					Spencer (Jacob)	4
		Oil in company	10							Suſpenſe-acct	5
										Sugar	7
										Stuffs	8
										Ship Phœnix in company	8
										Sherry in comp.	9

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		Voy. from Jam.	6	Wood (George)	10						
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		Van Beek his accompt on time	7								
		Van Beek his accompt-current	7								
		Voy. to Liſbon in company	9								

(1) LEDGER. LEDGER. (1)

No 1 — Cash, Dr

			Fo	l.	s.	d.
1769						
Jan.	1	To *Stock*, for ready money, -	2	12000	00	00
Feb.	5	To *Thomas Freeman*, received in full,	[illegible]	96	00	00
	25	To *Druggets*, for 10 pieces, at 8*l*. 3*s*.	3	81	10	00
Mar	4	To *Kerseys*, in part for 90 pieces, at 6*l*. 7*s*. - -	3	300	00	00
	2[illegible]	To *Broad Cloth*, in part for 400 yds,	3	150	14	08
	23	To *Bills receivable* of *Henry Sidney* in full, - -	4	141	13	04
Apr.	1	To *John Keil*, in full for kerseys,	4	270	00	00
	6	To *George Young*, in full for broad cloth, - -	4	280	00	00
	22	To *Indian chints*, a balance in barter,	1	46	02	00
May	31	To *J. Jeffop his accompt current*,	5	200	00	00
July	9	To *Voyage from Jamaica*, in part for indigo, - -	6	80	13	00
	30	To *Edward Dupper*, in full of my bill.	7	108	19	07
Aug	3	To *Nathaniel Napier*, in part for druggets, - - -	6	62	00	00
	17	To *H. V. Beek his accompt of goods*,	7	420	00	00
Sept.	1	To *Ship Britannia*, for freight,	1	72	10	00
	10	To *Profit and Lofs*, for 6 months intereft of 1000*l*. - -	6	25	00	00
	28	To *Voyage to Hamburg*, for drawback on fugar, - -	7	8	05	04½
Oct.	9	To *Edward Hopkins my accompt in company*, - -	8	27	07	04
	11	To *Edward Hopkins my accompt proper*, - - -	8	60	00	00
	20	To *Edward Hopkins my accompt in company*, - -	8	30	00	00
	25	To *Ship Phœnix in company*, for 1 month's freight, - -	8	22	00	00
				14482	15	03½

Contra, Cr

			Fo	l.	s.	d.
1769						
Jan.	6	By *Cambrics*, for 40 pieces, at 2*l*. 16*s*.	2	112	00	00
	15	By *Jofeph Martin*, in full, - -	2	36	00	00
	—	By *Druggets*, in part for 26 pieces, at 7*l*. 10*s*.	3	97	10	00
	21	By *Voy.* to Jamaica, paid charges and prem.	3	24	11	04
	30	By *J. Ruffel*, in full for druggets, -	3	97	10	00
Feb.	2	By *Broad Cloth*, in part for 1000 yds, at 13*s*. 6*d*.	3	330	00	00
	16	By *Sundries*, as *per* Journal, -		765	00	00
Mar	10	By *John Vernon*, in full for duroys,	3	130	00	00
	—	By *J. Spencer*, lent him for 6 M°, at 5 *per c*.	4	1000	00	00
	23	By *Jacob Green*, in part for holland,	3	73	11	00
May	[illegible]	By *Edward Harley*, in full, -	3	300	00	00
	13	By *Refufal of bargains*, - -	5	2	02	00
	18	By *J. Jeffop his acct-curt.* for leather, &c.	5	241	04	00
	22	By *George Aiton*, in full, -	5	1	05	00
June	[illegible]	By Sir *Ifaac Crifp*, in part, - -	2	80	00	00
	22	By *George Dennis*, in full -	5	85	06	06
	2[illegible]	By Sir *Ifaac Crifp*, in full, - -	2	40	00	00
July	2	By *Charges of mer.* paid ½ year's fhop-rent,	7	12	00	00
	5	By *Charges of mer.* paid poftage, &c.	7	2	12	08
	9	By *Voyage from Jamaica*, for charges paid,	6	97	12	00
	22	By *Voy. to Hamburg*, for lead and charges,	7	117	10	08
Aug.	6	By *Edward Harley*, lent him at 5 *per cent*.	3	400	00	00
	10	By *H. V. Beek his acct of goods*, for charges,	7	14	12	06
	2[illegible]	By *H. V. Beek his accompt of goods*,	7	1	07	06
	3[illegible]	By *H. V. Beek his acct-current*, for tobacco,	7	70	08	02
	31	By *James Wright*, in full, -	8	0	12	00
Sept.	8	By *H. V. Beek his acct-curt*, remitted him,	7	53	06	08
	10	By *Bills Payable*, - -	8	200	00	00
Oct.	4	By *Edward Hopkins my acct in company*	8	60	00	00
	2[illegible]	By *Profit and Lofs*, paid lofs of a wager,	6	2	02	00
	—	By *Ship Phœnix in company*, for my ½ fhare,	8	320	00	00
	25	By *Ship Phœnix in company*, paid repairs,	8	16	1[illegible]	00
	—	By *New accompt*. - -	9	9[illegible]	00	03½
				14482	15	03½

No 2 — Linen, Dr

			Yards.	Fo	l.	s.	d.
1769							
Jan.	1	To *Stock*, at 2*s*. 6*d*. for	2000	2	250	00	00
		To *Profit and Lofs*, gained,	——	6	20	16	08
					270	16	08

Contra, Cr

			Yards.	Fo	l.	s.	d.
1769							
Apr.	16	By *Sundries*, in bart. at 2*s*. 8*d*. for	1000		13[illegible]	[illegible]6	[illegible]8
	30	By *George Dennis*, at 2*s*. 9*d*. for	1000	5	137	10	00
			2000		270	16	08

No 3 — Indian chints, Dr

			Pieces	Fo	l.	s.	d.
1769							
Jan.		To *Stock*, at 24*l*. 10*s*. for	15	2	367	10	00
		To *Profit and Lofs*, gained,	—	6	3	10	00
					371	00	00

Contra, Cr

			Pieces.	Fo	l.	s.	d.
1769							
Apr.	10	By *Leckrams*, in barter, at 25*l*. for	— 2	4	50	00	00
	22	By *Sund.* in bart. at 24*l*. 15*s* for	— 6		148	10	00
	30	By *George Dennis*, at 25*l*.	— 2	5	50	00	00
		By *Balance*, remaining at 24*l*. 10*s*.	— 5	11	122	10	00
			15		371	00	00

No 4 — Ship Britannia, Dr

			Fo	l.	s.	d.
1769						
Jan.	1	To *Stock*, for ¼ part, - -	2	348	10	00
		To *Profit and Lofs*, gained, -	6	72	10	00
				421	00	00

1 — Contra, Cr

Date			Fo	l.	s.	d.
1769						
Sept.	1	By *Cafh*, for my ¼ of freight, -	1	72	10	00
		By *Balance*, for my ¼ remaining,	11	34[illegible]	[illegible]0	00
				421	00	00

(2) LEDGER, | LEDGER. (2)

N°	Date	Day		Pieces	Fo	l.	s.	d.	Date	Day		Pieces	Fo	l.	s.	d.
5			*John Harris,* Dr								*Contra,* Cr					
	1769 Jan	1	To *Stock*, per note on demand, -		2	45	00	00	1769 Feb.	2	By *Broad Cloth*, for my bill on him,		3	45	00	00
6			*Thomas Freeman,* Dr								*Contra,* Cr					
	1769 Jan.	1	To *Stock*, *per* bill due *February* 2.		2	96	00	00	1769 Feb.	5	By *Cash*, received in full, - -		1	96	00	00
	Aug.	23	To *H. Van Beek his accompt of goods*, at 6 months, - -		7	54	00	00			By *Balance*, for *Van Beek*'s flax,		11	54	00	00
						150	00	00						150	00	00
7			*George Evans,* Dr								*Contra,* Cr					
	1769 Jan.	1	To *Stock*, *per* bond at 5 *per cent.*		2	300	00	00	1769 Nov.	12	By *Sundries*, as *per* Journal, -			300	00	00
8			*Stock,* Dr								*Contra,* Cr					
	1769 Jan.	1	To *Joseph Martin*, on demand, -		2	36	00	00	1769 Jan.	1	By *Cash*, for ready money, -		1	12000	00	00
			To *Sir Isaac Crisp*, due *June* 1.		2	120	00	00			By *Linnen*, 2000 yards, at 2s. 6d.		1	250	00	00
			To *Balance*, the neat of my estate,		11	13474	15	03			By *Indian Chints*, 15 pieces, at 24l. 10s. - - - -		1	367	10	00
						13630	15	03			By *Ship Britannia*, for $\frac{1}{4}$ part, -		2	348	10	00
											By *John Harris*, *per* note on demand,		2	45	00	00
											By *Thomas Freeman*, *per* bill due *Feb.* 2.		2	96	00	00
											By *George Evans*, *per* bond at 5 *per cent.* - - - -		2	300	00	00
											By *Profit and Loss*, gained since the 1st of *January* last, - - -		6	223	15	03
														13630	15	03
9			*Joseph Martin,* Dr								*Contra,* Cr					
	1769 Jan.	15	To *Cash*, paid him in full, -		1	36	00	00	1769 Jan	1	By *Stock*, on demand - -		2	36	00	00
10			*Sir Isaac Crisp,* Dr								*Contra,* Cr					
	1769 June	8	To *Cash*, paid him in part, -		1	80	00	00	1769 Jan.	1	By *Stock*, dated *June* 1. - -		2	120	00	00
		29	To *Cash*, paid him in full, -		1	40	00	00								
						120	00	00								
11			*Cambrics,* Dr	*Pieces.*							*Contra,* Cr	*Pieces.*				
	1769 Jan.	6	To *Cash*, at 2l. 16s. for	40	1	112	00	00	1769 Oct.	9	By *Sundries*, at 3l. for	40		120	00	00
			To *Profit and Loss*, gained		6	8	00	00								
						120	00	00								
12			*Duroys,* Dr	*Pieces.*							*Contra,* Cr	*Pieces.*				
	1769 Jan.	10	To *John Vernon*, at 26s. for	100	3	130	00	00	1769 Jan.	21	By *Voyage to Jamaica*, at 26s. for - -	70	3	91	00	00
											By *Balance*, remaining, at 26s.	30	11	39	00	00
												100		130	00	00

John

N°	1769		Dr	Quantity	Fo	l.	s.	d.
13			*John Vernon*, Dr					
	Mar	1	To *Cash*, paid him in full, -		1	130	00	00
	June	2	To *Profit and Loss*, for Dr *Friend's* legacy, - - -		6	200	00	00
						330	00	00

1769		Cr	Quantity	Fo	l.	s.	d.
		Contra, Cr					
Jan.	10	By *Duroys*, to pay at 2 months,		3	130	00	00
		By *Balance*, due by him, - -		11	200	00	00
					330	00	00

N°	1769		Dr	Pieces.	Fo	l.	s.	d.
14			*Druggets*, Dr					
	Jan.	1	To *Sundries*, at 7 *l*. 10 *s*. for	26	6	195	00	00
			To *Profit and Loss*, gained,	—		10	10	00
						205	10	00

1769		Cr	Pieces.	Fo	l.	s.	d.
		Contra, Cr					
Feb.	25	By *Cash*, at 8 *l*. 3 *s*. for	10	1	81	10	00
May	7	By *Suspense-accompt*, at 7 *l*. 15 *s*. for -	16	5	124	00	00
			26		205	10	00

N°	1769		Dr		Fo	l.	s.	d.
15			*Jacob Russel*, Dr					
	Jan.	30	To *Cash*, paid him in full, -		1	97	10	04
			To *Balance*, due to him, -		11	49	10	08
						147	00	00

1769		Cr		Fo	l.	s.	d.
		Contra, Cr					
Jan.	15	By *Druggets*, on demand, - -		3	97	10	00
July	22	By *Voyage to Hamburg*, due at six M°.		7	49	10	00
					147	00	00

N°	1769		Dr		Fo	l.	s.	d.
16			*Voyage to Jamaica*, Dr					
	Jan.	21	To *Sundries*, as *per* Journal, -			223	12	00
			To *Profit and Loss*, gained, -		6	80	15	00
						304	07	00

1769		Cr		Fo	l.	s.	d.
		Contra, Cr					
June	18	By *Sundries*, as *per* Journal, -			304	07	00

N°	1769		Dr		Fo	l.	s.	d.
17			*Jacob Green*, Dr					
	Mar	23	To *Sundries*, paid him in full, -			108	00	00

1769		Cr		Fo	l.	s.	d.
		Contra, Cr					
Jan.	21	By *Voyage to Jamaica*, to pay at 2 M°.		3	108	00	00

N°	1769		Dr	Yards.	Fo	l.	s.	d.
18			*Broad Cloth*, Dr					
	Feb.	2	To *Sundries*, at 13 *s*. 6 *d*. for	1000		675	00	00
			To *Profit and Loss*, gained ·	—	6	32	10	00
						707	10	00

1769		Cr	Yards.	Fo	l.	s.	d.
		Contra, Cr					
Mar	1	By *George Young*, at 14 *s*. for	400	4	280	00	00
	17	By *Bills receivable*, at 14 *s*. 2 *d*. for - - -	200	4	141	13	04
	22	By *Sundries*, at 14 *s*. $3\frac{1}{2}$ *d*. for	400		285	16	08
			1000		707	10	00

N°	1769		Dr		Fo	l.	s.	d.
19			*Edward Harley*, Dr					
	May	2	To *Cash*, paid him in full, -		1	300	00	00
	Aug.	6	To *Cash*, lent him at 5 *per cent*.		1	400	00	00
						700	00	00

1769		Cr		Fo	l.	s.	d.
		Contra, Cr					
Feb.	2	By *Broad Cloth*, due at 3 months,		3	300	00	00
Nov.	8	By *Cash*, for principal, - -		9	400	00	00
					700	00	00

N°	1769		Dr	Pieces.	Fo	l.	s.	d.
20			*Kerseys*, Dr					
	Feb.	16	To *Cash*, at 6 *l*. for -	90	1	540	00	00
	Apr.	1	To *John Keil*, abated -	—	4	1	10	00
			To *Profit and Loss*, gained,	—	6	30	00	00
						571	10	00

1769		Cr	Pieces.	Fo	l.	s.	d.
		Contra, Cr					
Mar	4	By *Sundries*, at 6 *l*. 7 *s*. for	90		571	10	00

N°	1769		Dr	Pieces.	Fo	l.	s.	d.
21			*Fustians*, Dr					
	Feb.	16	To *Cash*, at 37 *s*. 6 *d*. for	120	1	225	00	00

		Cr	Pieces.	Fo	l.	s.	d.
		Contra, Cr					
		By *Balance*, remain. at 37 *s*. 6 *d*.	120	11	225	00	00

(4) LEDGER. LEDGER. (4)

No 22

		George Young, Dr		Fo	l.	s.	d.			Contra, Cr		Fo	l.	s.	d.
1769								1769							
Mar.	1	To *Broad Cloth*, to pay at 1 month,		3	280	00	00	Ap.	6	By *Cash*, received in full,		1	80	00	00
Dec.	2	To *Oil in company*, due at 10 days,		10	100	00	00	Dec.	13	By *Cash*, received in full,		9	100	00	00
					80	00	00						380	00	00

23

		John Keil, Dr		Fo	l.	s.	d.			Contra, Cr		Fo	l.	s.	d.
1769								1769							
Mar	4	To *Kerseys*, to pay at 20 days, -		3	271	10	00	Apr.	1	By *Sundries*, as *per* Journal,			271	10	00

24

		Jacob Spencer, Dr		Fo	l.	s.	d.			Contra, Cr		Fo	l.	s.	d.
1769															
Mar	10	To *Cash*, lent him at 5 *per cent.*		1	1000	00	00			By *Balance*, due by him,		11	1000	00	00

25

		Bills receivable, Dr		Fo	l.	s.	d.			Contra, Cr		Fo	l.	s.	d.
1769								1769							
Mar	17	To *Broad Cloth*, for 1 on *Henry Sidney*.		3	141	13	04	Mar	23	By *Cash*, received of *Henry Sidney* in full,		1	141	13	04
	22	To *Broad Cloth*, for 1 on *George Digby*,		3	100	00	00			By *Balance* remaining,					
Sept.	30	To *J. Perkins my accompt-current*, for		8						1 on *George Digby*, L. 100 00 00					
		1 on *John Alston*, L. 80 00 00								1 on *J. Alston*, 80 00 00					
		1 on *Jacob Finch*, 120 00 00			238	07	8½			1 on *J. Finch*, 120 00 00			383	07	8½
		1 on *Stephen Morden*, 38 07 08½								1 on *Stephen Morden*, 38 07 08½					
Oct.	9	To *Ed. Hopkins my accompt in comp.* for 1 on *Rich. Addison*,		8	45	00	00			1 on *Rich. Addison*, 45 00 00					
					525	01	00½						525	01	00½

26

		Foreign coin, Dr	Moidores.	Fo	l.	s.	d.			Contra, Cr	Moidores.	Fo	l.	s.	d.
1769								1769							
Mar	22	To *Broad Cloth* at 27*s.* for	26	3	35	02	00	Mar	23	By *Jacob Green*, at 26*s.* 6*d.* for	26	3	34	09	00
										By *Profit and Loss*, lost,	—	6	0	13	00
													35	02	00

27

		Lockrams, Dr	Pieces.	Fo	l.	s.	d.			Contra, Cr	Pieces.	Fo	l.	s.	d.
1769															
Apr.	10	To *Indian Chints*, in barter at 25*s.*	40	1	50	00	00			By *Balance* remaining, at 25*s.*	40	11	50	00	00

28

		Cochineal, Dr	C.	Fo	l.	s.	d.			Contra, Cr	C.	Fo	l.	s.	d.
1769															
Apr.	16	To *Linen*, in barter, -	1	1	108	16	00			By *Balance* remaining, -	1	11	108	16	00

29

		Cinnamon, Dr	lb.	Fo	l.	s.	d.			Contra, Cr	lb.	Fo	l.	s.	d.
1769															
Apr.	16	To *Linen*, in barter at 7*s.* 8*d.*	64	1	24	10	08			By *Balance*, remain. at 7*s.* 8*d.*	64	11	24	10	08

Nº				Fo	l.	s.	d.					Fo	l.	s.	d.
30		*Muslin*, Dr	Bales.							*Contra*, Cr	Bales.				
1769 *Apr.*	22	To *Indian Chints*, at 12 *l.* 16 *s.* for - - -	8	1	102	08	00			By *Balance*, remaining, at 12 *l.* 16 *s.* - -	8	11	102	08	00
31		*George Dennis*, Dr								*Contra*, Cr					
1769 *Apr.*	30	To *Sundries*, as *per* Journal, -			187	10	00	1769 *Apr.*	30	By *Sundries*, as *per* Journal, -			164	16	06
June	22	To *Cash*, paid him in full, -		1	85	06	06	*May*	18	By *J. Jessop his acct-curt*, at 1 month,		5	108	00	00
					272	16	06						272	16	06
32		*Cotton*, Dr	C.Q.							*Contra*, Cr	C.Q.				
1769 *Apr.*	30	To *G. Dennis*, at 3*l.* 15*s.* *per* C.	42 2	5	159	07	06			By *Balance*, remaining, at 3*l.* 15*s.*	42 2	11	159	07	06
33		*Cloves*, Dr	lb.							*Contra*, Cr	lb				
1769 *Apr.*	20	To *George Dennis*, at 9*s.* 1*d.* for	12	5	5	09	00			By *Balance*, remaining, at 9*s.* 1*d.*	12	11	5	09	00
Oct.	30	To *E. Hopkins*, *my accompt in company*, at 9 *s*, for -	72	8	32	08	00			———— and at 9*s.*	72		32	08	00
			84		37	17	00				84		37	17	00
34		*Suspense-accompt*, Dr								*Contra*, Cr					
1769 *May*	7	To *Druggets*, sent *Nathaniel Napier*, 16 pieces, - -		3	124	00	00	1769 *June*	16	By *Nathaniel Napier*, - -		6	124	00	00
35		*Refusal of Bargains*, Dr								*Contra*, Cr					
1769 *May*	13	To *Cash*, paid penalty for refusing *Norwich* stuffs, - - -		1	2	02	00			By *Profit and Loss*, lost, - -		6	2	02	00
36		*John Jessop his acct-curt.* Dr								*Contra*, Cr					
1769 *May*	18	To *Sundries*, as *per* Journal, -			360	15	00	1769 *May*	31	By *Cash*, for my bill, value received,		1	200	00	00
										By *Balance*, due by him, - -		11	160	15	00
													360	15	00
37		*George Aiton*, Dr								*Contra*, Cr					
1769 *May*	22	To *Cash*, paid him in full, - -		1	1	5	00	1769 *May*	18	By *J. Jessop his acct-curt.* for packing,		5	1	05	00

6 LEDGER. | LEDGER. (6)

Nº 38

Profit and Loss, Dr

			Fo	l.	s.	d.
1769 Oct.	22	To *Cash*, paid loss of wager, -	1	2	02	00
Nov.	1	To *George Evans*, abated, - -	2	120	00	00
		To *Foreign Coin*, lost, - -	4	0	3	00
		To *Refusal of Bargains*, - -	5	2	02	00
		To *Voyage from Jamaica*, -	6	34	01	11
		To *Charges of merchandize*, -	7	14	12	08
		To *House-expences*, - -	9	240	00	00
		To *Stock*, neat gain since 1st *Jan.* last,	2	223	15	03
				627	06	10

Contra, Cr

			Fo	l.	s.	d.
1769 May	8	By *J. Jessop his accompt-current*, for my commission, - -	5	10	05	00
June	3	By *John Vernon*, for a legacy,	3	200	00	00
Aug.	23	By *H. V. Beek his accompt of goods*, for my commission, - - -	7	12	05	00
	30	By *H. V. Beek his accompt-current*, for commission, at $2\frac{1}{2}$, - - -	7	3	07	06
Sept.	10	By *Cash*, for 6 months int. of 1000 *l.*	1	25	00	00
Nov.	1	By *Sherry in comp.* for my commission,	9	7	08	06
	8	By *Cash*, for 3 months interest of 400*l.*	9	5	00	00
		By *Linen*, gained, - -	1	20	16	08
		By *Indian Chints*, gained, - -	1	3	10	00
		By *Ship Britannia*, gained, -	1	72	10	00
		By *Cambrics*, gained, - -	2	8	00	00
		By *Druggets*, gained, - -	3	10	10	00
		By *Voyage to Jamaica*, gained, -	3	80	15	08
		By *Broad Cloth*, gained - -	3	32	10	00
		By *Kerseys*, gained, - -	3	30	00	00
		By *Pymento*, gained, - -	7	25	11	08
		By *Voyage to Hamburg*, gained, -	7	16	17	$08\frac{1}{2}$
		By *John Perkins my accompt-current*,	8	2	17	$08\frac{1}{2}$
		By *Ed. Hopkins my acct in comp.* gained,	8	14	15	04
		By *Stuffs*, gained, - -	8	9	00	00
		By *Ship Phœnix in company*, gained,	8	34	15	00
		By *Sherry in company*, gained, -	9	4	03	09
		By *Oil in company*, gained, -	10	4	16	08
		By *Canary in company*, gained, -	11	2	10	08
				637	06	10

39

Nathaniel Napier, Dr

			Fo	l.	s.	d.
1769 June	16	To *Suspense-accompt*, 1st *August* and *Martinmass*, - -	5	124	00	00

Contra, Cr

			Fo	l.	s.	d.
1769 Aug.	3	By *Cash*, in part, - - -	1	62	00	00
Nov.	12	By *Cash*, in full, - -	9	62	00	00
				124	00	00

40

Voyage from Jamaica, Dr

			Fo	l.	s.	d.
1769 June	18	To *Voyage to Jamaica*, for returns,	3	195	07	05
July	9	To *Cash*, for charges here, -	1	97	12	00
				292	19	05

Contra, Cr

			Fo	l.	s.	d.
1769 July	9	By *Sundries*, as *per* Journal, -		160	13	00
	10	By *Sundries*, as *per* Journal, - -		98	04	06
		By *Profit and Loss*, - -	6	34	01	11
				292	19	05

41

William Boyd my acct-curt, Dr

			Fo	l.	s.	d.
1769 Jun.	18	To *Voyage to Jamaica*, balance in his hands, - - -	3	108	19	07

Contra, Cr

			Fo	l.	s.	d.
1769 July	15	By *Edward Dupper*, due at 10 days,	7	108	19	07

(7) LEDGER. | LEDGER. (7)

N°	Date	Day	Dr	Qty	Fo	l.	s.	d.	Date	Day	Cr	Qty	Fo	l.	s.	d.
42			*Charges of Merchandize*, Dr								*Contra*, Cr					
	1769 July	2	To *Cash*, for ½ year's shop-rent, -		1	12	00	00			By *Profit and Loss*, - -		6	14	12	08
		5	To *Cash*, paid postage, &c. -		1	2	12	08								
						14	12	08								
43			*John Dyer*, Dr								*Contra*, Cr					
	1769 July	9	To *Voyage from Jamaica*, due at 6 Mo.		6	80	00	00			By *Balance* due by him, - -		11	80	00	00
44			*Pymento*, Dr	lb.							*Contra*, Cr	lb.				
	1769 July	10	To *Voy. from Jamaica*, at 6*d*. for	1535	6	38	07	06	1769 Aug	30	By *H. V. Beek his accompt-current*, at 10*d*. -	1535	7	63	19	02
			To *Profit and Loss*, gained,		6	25	11	08								
						63	19	02								
45			*Sugar*, Dr	C.							*Contra*, Cr	C.				
	1769 July	10	To *Voy. from Jamaica*, at 19*s*. for	63	6	59	17	00	1769 July	22	By *Voy. to Hamburg*, at 19*s*. for	63	7	59	17	00
46			*Edward Dupper*, Dr								*Contra*, Cr					
	1769 July	15	To *Wil. Boyd, my acc. curt.* at 10 days,		6	108	19	07	1769 July	30	By *Cash*, received in full, - -		1	108	19	07
47			*Voyage to Hamburg*, Dr								*Contra*, Cr					
	1769 July	22	To *Sundries*, as *per* Journal, -			226	17	08	1769 Sept.	22	By *John Perkins my accompt-current*,		8	235	10	00
			To *Profit and Loss*, gained, -		6	16	17	08½		28	By *Cash*, for drawback on sugar,		1	8	05	04½
						243	15	04½						243	15	04½
48			*Herman Van Beek his accompt of goods*, Dr								*Contra*, Cr					
	1769 Aug.	10	To *Cash*, paid charges, - -		1	14	12	06	1769 Aug	17	By *Cash*, for 14 butts madder, -		1	420	00	00
		23	To *Cash*, for storage, brokerage, &c.		1	1	07	06		23	By *Tho. Freeman*, for 18 C. flax, due at months, - - -		2	54	00	00
			To *Profit and Loss*, for my commis. at 2½,		6	12	05	00						474	00	00
		—	To *H. Van Beek his accompt on time*, due by *T. Freeman*, -		7	54	00	00								
		—	To *ditto his accompt-current*, in my hands		7	391	15	00								
						474	00	00								
49			*Herman Van Beek his accompt on time*, Dr								*Contra*, Cr					
			To *Balance*, outstanding, -		11	54	00	00	1769 Aug	23	By *H. V. Beek his accompt of goods*, due by *T. Freeman*, - -		7	54	00	00
50			*Herman Van Beek his accompt current*, Dr								*Contra*, Cr					
	1769 Aug.	30	To *Sundries*, as *per* Journal			138	07	06	1769 Aug.	23	By *H. Van Beek his accompt of goods*,		7	391	15	00
	Sept.	3	To *Bills payable*, for 1 to *W. Sabin*, at 6 days - - -		8	200	00	00		31	By *James Wright*, abated, -		8	0	00	08
		8	To *Cash*, remitted him,		1	53	06	08						391	15	08
			To *Balance*, due to him, -		11	0	01	06								
						391	15	08								

(8) LEDGER. LEDGER, (8)

N°					Fo	l.	s.	d.					Fo	l.	s.	d.
51			*James Wright,* Dr								*Contra,* Cr					
	1769 Aug.	31	To *Sundries*, as *per* Journal, -			0	12	08	1769 Aug.	30	By *H.V.Beek his acct-cur.* for cooperage,		7	0	12	08
52			*Bills payable,* Dr								*Contra,* Cr					
	1769 Sept.	10	To *Cash*, paid *Wil. Sabin Van Beek*'s bill,		1	200	00	00	1765 Sept.	3	By *H.V. Beek his acc-cur.* for 1 at 6 days,		7	200	00	00
53			*John Perkins my acct-current,* Dr	Flemish. l. s. d.							*Contra,* Cr	Flemish. l. s. d.				
	1769 Sept.	22	To *Voy. to Hamb.* at 34*s.* 5*d.*	405 5 1½	7	235	10	00	1769 Sept.	30	By *Bills receivable*, exch. at 34*s.* for - -	405 5 0½	4	238	07	08½
			To *Profit and Loss* -		6	2	17	08½								
						238	07	08½								
54			*Edward Hopkins my accompt in company,* Dr								*Contra,* Cr					
	1769 Oct.	4	To *Cash*, paid ½ share of 10 hhds tobacco,		1	60	00	00	1769 Oct.	9	By *Sundries*, as *per* Journal, -			72	07	04
		9	To *Cambrics*, for my ½ share of 40 ps. at 3*l.*		2	60	00	00		20	By *Sundries*, as *per* Journal, -			62	08	00
			To *Profit and Loss*, gained, -		6	04	15	04						134	15	04
						134	15	04								
55			*Edward Hopkins my accompt proper,* De								*Contra,* Cr					
	1769 Oct.	9	To *Cambrics*, for his ½ share of 40 ps. at 3*l.*		2	60	00	00	1769 Oct.	11	By *Cash*, received in full, - -		1	60	00	00
56			*Stuffs,* Dr	Pieces.							*Contra,* Cr	Pieces.				
	1769 Oct.	21	To *James Ward*, at 2*l.* 8*s.* for	90	8	216	00	00	1759 Nov.	15	By *Voyage to Lisbon in company*, at 2*l.* 10*s.* for	90	9	225	00	00
			To *Profit and Loss*, gained,		6	9	00	00								
						225	00	00								
57			*James Ward,* Dr								*Contra,* Cr					
			To *Balance* due to him,		11	216	00	00	1759 Oct.	21	By *Stuffs*, to pay at 3 months, -		8	216	00	00
58			*Ship Phœnix in company with George Kent,* Dr								*Contra,* Cr					
	1769 Oct.	22	To *Sundries*, as *per* Journal, -			640	00	00	1769 Oct.	25	By *Cash* for 1 month's freight, -		1	22	00	00
		25	To *Cash*, paid repairs - -		1	16	10	00	Dec.	27	By *Cash*, for 1 month's freight, -		9	22	00	00
		—	To *Cash*, paid premium on 600*l.*		9	18	00	00		28	By *Mr Jones and company*, sold		11	700	00	00
			To *G.Kent his acct in Co.* for his ½ gained,		8	34	15	00						744	00	00
			To *Profit and Loss*, for my half gained,		6	34	15	00								
						744	00	00								
			George Kent his accompt in company, Dr								*Contra,* Cr					
	1769 Oct.	25	To *ditto his accompt proper* for his ½ of 1 month's freight, - -		9	11	00	00	1769 Oct.	22	By *Ship Phœnix in Co.* for his ½ share,		8	320	00	00
	Nov.	29	To *ditto his accompt-proper*, for ½ of 5 pipes of sherry, - -		9	72	10	00		25	By *ditto his acct proper*, for half repairs,		9	8	05	00
	Dec.	1	To *ditto his acct prop.* for ½ of 4 pip. sherry		9	55	01	00		—	By *ditto his acct prop.* for his ½ of prem.		9	9	00	00
	Nov.	27	To *ditto his acct prop.* for ½ of freight,		9	11	00	00		26	By *ditto his acct proper*, for his half of 9 pipes sherry, - - -		9	118	05	00
	Dec.	28	To *ditto his accompt-proper* for ½ of *Phœnix*, sold, - -		9	350	00	00	Nov.	1	By *ditto his acct proper*, for his half carriage, &c. -		9	1	11	00
						499	14	00		—	By *ditto his acct prop.* for his ½ of commis.		9	3	14	03
											By *Sh. Phœnix in Co.* for his ½ share gained,		8	34	15	00
											By *Sherry in camp.* for his half gained,		9	4	03	09
														499	14	00

(9) LEDGER. — Dr

No.					Fo	l.	s.	d.
60			*George Kent his acct prop.* Dr					
	1769 Oct.	25	To *dit. his acct in com.* for hi half repairs,		8	8	05	00
		—	To *dit. his ac. in com.* for his half premium.		8	9	00	00
		26	To *dit. his ac. in com.* for ½ of 9 pipes sherry,		8	118	05	00
	Nov.	1	To *dit. his acct in comp.* for ½ carriage.		8	1	11	00
		—	To *dit. his acct in comp.* for his ½ of com.		8	3	14	03
		4	To *Cash* paid him, - -		9	122	08	09
			To *Balance*, due to him, - -		11	361	00	00
						624	04	00
61			*Cash,* Dr					
	1769 Oct.	25	To *old accompt*, - - -		1	9698	00	03½
		27	To *George Kent his accompt proper*,		9	124	10	00
		29	To *Sherry in co.* in part for 5 pipes, at 29 *l.*		9	120	00	00
		1	To *Sherry in com.* for 4 pipes, at 27 *l.* 12 *s.*		9	110	08	00
		—	To *Ed. Turner*, in full for sherry,		9	25	00	00
		8	To *Sundries*, as *per* Journal, -			405	00	00
		12	To *George Evans*, received in composition,		2	180	00	00
		—	To *N. Napier*, in full for druggets.		6	62	00	00
		25	To *S. King his acct prop.* received of him,		10	34	00	00
	Dec.	2	To *Oil in co.* in part for 7 tuns, at 30*l.* 10*s.*		10	113	10	00
		13	To *George Young*, in full, -		4	100	00	00
		1[illegible]	To *Canary in co.* for 6 pipes, at 29 *l.* 12 *s.*		11	177	12	00
		20	To *J. Fuller*, recd in composn of his debt,		10	12	00	00
		27	To *Ship Phœnix in co.* for 1 M° freight,		8	22	00	00
						11184	00	03½
62			*Sherry in company with George Kent.* Dr	Pipes				
	1769 Oct.	26	To *Richard Owen*, at 26 *l.* for	4	9	104	00	00
			——— at 26 *l.* 10 *s.* for	5	—	132	10	00
	Nov.	1	To *Cash*, paid carriage, *&c.*	—	9	3	02	00
		—	To *Profit and Loss*, for my commis. at ½ *per cent.*	—	6	7	08	06
			To *Geo. Kent his accompt in company* for his ½ gained,	—	8	4	03	09
			To *Profit and Loss*, for my half gained, - -	—	6	4	03	09
				9		255	08	00
63			*Richard Owen,* Dr					
	1769 Oct.	27	To *Cash*, paid him in full, -		9	236	10	00
64			*Edward Turner,* Dr					
	1769 Oct.	29	To *Sherry on company*, on demand,		9	25	00	00
65			*House-expences,* Dr					
	1769 Nov.	11	To *Cash*, paid 1 year's rent of my dwelling-house, - - -		9	40	00	00
	Dec.	30	To *Cash*, laid out since the 1st of *Jan.* last,		9	200	00	00
						240	00	00
66			*Voyage to Lisbon in com. with Simon King and John Oker,* Dr					
	1769 Nov.	15	To *Sundries* as *per* Journal, -			995	00	00

LEDGER. (9) — Cr

				Fo	l.	s.	d.
		Contra, Cr					
1769 Oct.	25	By *dit. his acct. in comp.* for his ½ freight,		8	11	00	00
	27	By *Cash*, for his half of disbursements and sherry, - - -		9	124	10	00
	29	By *dit. his acct in co.* for ½ of 5 pipes sherry,		8	72	10	00
Dec.	1	By *dit. his acct in co.* for ½ of 4 pipes sherry,		8	55	04	00
	27	By *ditto his acct in comp.* for ½ of freight,		8	11	00	00
	28	By *dit. his acct in co.* for ½ of *Phœnix* sold,		8	350	00	00
					624	04	00
		Contra, Cr					
1769 Oct.	25	By *Ship Phœnix in company*, for premium		8	18	00	00
	27	By *Richard Owen*, in full for sherry,		9	236	10	00
Nov.	1	By *Sherry in company*, paid carriage, *&c.*		9	3	2	00
	4	By *Geo. Kent his accompt proper*, paid him,		9	122	08	09
	11	By *House-expences*, paid one year's rent,		9	40	00	00
	15	By *Voyage to Lisbon in company*, -		9	50	00	00
	17	By *Simon King his accompt proper*,		9	56	13	04
	25	By *George Wood*, paid him, - -		10	211	00	00
Dec.	30	By *House-expences*, since the 1st *Jan.* last		9	200	00	00
		By *Balance*, remaining in my hands,		11	10246	6	02½
					11184	00	03½
		Contra, Cr	Pipes				
1769 Oct.	29	By *Sundries*, at 29 *l.* for -	5		145	00	00
	1	By *Cash*, at 27 *l.* 12 *s.* for	4	9	110	08	00
			9		255	08	00
		Contra, Cr					
1769 Oct.	26	By *Sherry in company*, on demand,		9	236	10	00
		Contra, Cr					
1769 Nov.	1	By *Cash*, received in full, - -		9	25	00	00
		Contra, Cr					
		By *Profit and Loss*, - -			240	00	00
		Contra, Cr					
		By *Sim. King his acct in comp.* ⅓ remaining		10	331	13	04
		By *J. Oker his acct in comp.* ⅓ remaining,		10	331	13	04
		By *Balance*, for my ⅓ remaining, -		11	331	13	04
					995	00	00

(10) LEDGER. LEDGER. (10)

No 67

Date		Simon King, his acct prop. Dr	Fo	l.	s.	d.
1769 Nov.	15	To *ditto his accompt in comp.* for his $\frac{1}{3}$ of voyage to *Lisbon*, - -	10	331	13	04
	17	To *Sundries*, as *per* Journal, -		108	06	08
	22	To *dit. his ac. in co.* for his $\frac{1}{3}$ of 18 tuns oil,	10	177	00	00
Dec.	20	To *dit. his ac. in co.* for his $\frac{1}{3}$ of 18*l.* abated,	10	6	00	00
		To *Balance*, due to him, - -	11	134	07	04
				757	07	04

Date		Contra, Cr	Fo	l.	s.	d.
1769 Nov.	15	By *Voy. to Lisbon in co.* for 80 pieces serge,	9	440	00	00
	25	By *George Wood*, paid to him, -	10	120	00	00
	—	By *Sundries*, as *per* Journal, -		57	00	00
	30	By *dit. his ac. in co.* for his $\frac{1}{3}$ of 1 tun oil sold,	10	10	00	00
Dec.	2	By *dit. his ac. in co.* for his $\frac{1}{3}$ of 7 tuns oil sold,	10	71	03	04
	18	By *ditto his accompt in company*, for his $\frac{1}{3}$ of 6 pipes canary sold, - -	10	59	04	00
				757	07	04

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Date		John Oker his accompt-proper, Dr	Fo	l.	s.	d.
1769 Nov.	15	To *ditto his accompt in comp.* for his $\frac{1}{3}$ of voyage to *Lisbon*, - -	10	331	13	04
	22	To *dit. his ac. in co.* for his $\frac{1}{3}$ of 18 tuns oil,	10	177	00	00
	25	To *Simon King his acct-prop.* paid to him,	10	23	00	00
Dec.	20	To *dit. his ac. in co.* for his $\frac{1}{3}$ of 18*l.* abated,	10	6	00	00
		To *Balance*, due to him, - -	11	134	07	04
				672	00	08

Date		Contra, Cr	Fo	l.	s.	d.
1769 Nov.	15	By *Voy. to Lisbon in co.* for 70 pieces frieze,	9	280	00	00
	17	By *S. King his accompt-proper*, -	10	51	13	04
	25	By *George Wood*, paid to him, -	10	200	00	00
	30	By *dit. his ac. in co.* for his $\frac{1}{3}$ of 1 tun oil sold,	10	10	00	00
Dec.	2	By *dit. his ac. in co.* for his $\frac{1}{3}$ of 7 tuns oil sold,	10	71	03	04
	18	By *ditto his accompt in comp.* for his $\frac{1}{3}$ of 6 pipes canary sold, - -	10	59	04	00
				672	00	08

69

Date		Simon King his acct in co. Dr	Fo	l.	s.	d.
1769 Nov	30	To *dit. his ac. pr.* for his $\frac{1}{3}$ of 1 tun oil sold,	10	10	00	00
Dec.	2	To *dit. his ac. pr.* for his $\frac{1}{3}$ of 7 tuns oil sold,	10	71	03	04
	18	To *ditto his accompt-proper*, for his $\frac{1}{3}$ of 6 pipes canary sold, - -	10	59	04	00
	24	To *Canary in co.* for 2 pipes taken to himself,	11	50	00	00
		To *Voy. to Lisbon in co.* for his $\frac{1}{3}$ remaining,	9	331	13	04
				522	00	08

Date		Contra, Cr	Fo	l.	s.	d.
1769 Nov.	15	By *dit. his ac. pr.* for his $\frac{1}{3}$ of voy. to *Lisbon*,	10	331	13	04
	22	By *ditto his acct prop.* for his $\frac{1}{3}$ of 18 tuns oil bought, - -	10	177	00	00
Dec.	20	By *dit. his ac. prop.* for his $\frac{1}{3}$ of 18*l.* abated,	10	6	00	00
		By *Oil in company*, for his $\frac{1}{3}$ gained,	10	4	16	08
		By *Canary in company*, for his $\frac{1}{3}$ gained,	10	2	10	08
				522	00	08

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Date		John Oker his acct in comp. Dr	Fo	l.	s.	d.
1769 Nov.	30	To *dit. his ac. pr.* for his $\frac{1}{3}$ of 1 tun oil sold,	10	10	00	00
Dec.	2	To *dit. his ac. pr.* for his $\frac{1}{3}$ of 7 tuns oil sold,	10	71	03	04
	18	To *ditto his accompt-proper*, for his $\frac{1}{3}$ of 6 pipes canary sold, - -	10	59	04	00
	24	To *Canary in co.* for 2 pipes taken to himself,	11	50	00	00
		To *Voy. to Lisbon in co.* for his $\frac{1}{3}$ remaining,	9	331	13	04
				522	00	08

Date		Contra, Cr	Fo	l.	s.	d.
1769 Nov.	15	By *dit. his ac. pr.* for his $\frac{1}{3}$ of voy. to *Lisbon*,	10	331	13	04
	22	By *ditto his acct prop.* for his $\frac{1}{3}$ of 18 tuns oil bought, - - -	10	177	00	00
Dec.	20	By *dit. his ac. prop.* for his $\frac{1}{3}$ of 18*l.* abated,	10	6	00	00
		By *Oil in company*, for his $\frac{1}{3}$ gained,	10	4	16	08
		By *Canary in comp.* for his $\frac{1}{3}$ gained,	11	2	10	08
				522	00	08

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Date		Oil in co. with Simon King and J. Oker, Dr	Tuns	Fo	l.	s.	d.
1769 Nov.	22	To *George Wood*, at 29*l.* 10*s.* for	18	10	531	00	00
Dec.	20	To *James Fuller*, abated him,	—	10	18	00	00
		To *S. K. his ac. in co.* for his $\frac{1}{3}$ gained	—	10	4	16	08
		To *J. O. his ac. in co.* for his $\frac{1}{3}$ gained	—	10	4	16	08
		To *Profit and Loss*, for my $\frac{1}{3}$ gained,	—	6	4	16	08
					563	10	00

Date		Contra, Cr	Tuns	Fo	l.	s.	d.
1769 Nov.	30	By *James Fuller*, - -	1	10	30	00	00
Dec.	2	By *Sundries*, as *per* Journal,	7		213	10	00
	7	By *Canary in co.* in barter at 32*l.* for	10	11	320	00	00
			18		563	10	00

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Date		George Wood, Dr	Fo	l.	s.	d.
1769 Nov.	25	To *Sundries*, as *per* Journal, -		531	00	00

Date		Contra Cr	Fo	l.	s.	d.
1769 Nov.	22	By *Oil in company*, on demand, -	10	531	00	00

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Date		James Fuller, Dr	Fo	l.	s.	d.
Nov.	30	To *Oil in company*, to pay at 14 days,	10	30	00	00

Date		Contra, Cr	Fo	l.	s.	d.
1769 Dec.	20	By *Sundries*, as *per* Journal, -	6	30	00	00

N° 74

Canary in co. with S. King and J. Oker, Dr

Date			Pipes	Fo.	l.	s.	d.
1769 Dec.	7	To *Oil in company*, in barter	12	10	320	00	00
		To *S. King his acct in co.* for his $\frac{1}{3}$ gained,	—	10	2	10	08
		To *J. Oker his acct in comp.* for his $\frac{1}{3}$ gained,	—	10	2	10	08
		To *Profit and Loss*, for my $\frac{1}{3}$ gained,	—	6	2	10	08
					327	12	00

Contra, Cr

Date			Pipes	Fo.	l.	s.	d.
1769 Dec	18	By *Cash*, at 29 *l.* 12 *s.* fo	6		177	12	00
	24	By *Sundries*, at 25 *l.* fo	6		150	00	00
			12		327	12	00

75

Canary, Dr

Date			Pipes	Fo.	l.	s.	d.
1769 Dec.	24	To *Canary in co.* retained at 25*l.*	2	11	50	00	00

Contra, Cr

	Pipes	Fo.	l.	s.	d.
By *Balance*, remaining at 25*l.*	2	11	50	00	00

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Mr Jones and Company, Dr

Date			Fo.	l.	s.	d.
1769 Dec.	28	To *Ship Phœnix in co.* to pay at 3 M°.	8	700	00	00

Contra, Cr

	Fo.	l.	s.	d.
By *Balance*, outstanding, -	11	700	00	00

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Balance, Dr

	Fo.	l.	s.	d.
To *Cash*, remaining in my hands,	9	10246	06	02$\frac{1}{2}$
To *Indian Chints*, remaining 5 pieces, at 24*l.* 10*s.* - -	1	122	10	00
To *Ship Britannia*, for $\frac{1}{4}$ remaining,	1	348	10	00
To *Tho Freeman*, due for *V. Beek*'s flax,	2	54	00	00
To *Duroys*, rem. 30 pieces, at 26*s.*	2	39	00	00
To *John Vernon*, due by him,	3	200	00	00
To *Fustians*, rem. 120 pieces, at 37*s.* 6*d.*	3	225	00	00
To *Jacob Spencer*, lent him, -	4	1000	00	00
To *Bills receivable*, as *per* accompt,	4	383	07	08$\frac{1}{2}$
To *Lockrams*, rem. 40 pieces, at 25 *s.*	4	50	00	00
To *Cochineal*, remaining 1 C. -	4	108	16	00
To *Cinnamon*, rem. 64 lb. at 7 *s.* 8 *d.*	4	24	10	08
To *Muslin*, rem. 8 bales, at 12*l.* 16*s.*	5	102	08	00
To *Cotton*, rem. 42 C. 2 Q. at 3*l.* 15*s.*	5	159	07	06
To *Cloves*, remaining 12 lb. at 9*s.* 1*d.* and 72 lb. at 9*s.* - -	5	37	17	00
To *John Jessop, his ac. curt*, due by him,	5	160	15	00
To *John Dyer*, due by him, -	7	80	00	00
To *Voy. to Lisbon in co.* for my $\frac{1}{3}$ rem.	9	331	13	04
To *Canary*, remaining 2 pipes, at 25 *l.*	11	50	00	00
To *Mr Jones and Company*, outstanding,	11	700	00	00
		14424	01	05

Contra, Cr

	Fo.	l.	s.	d.
By *Jacob Russel*, due to him, -	3	49	10	00
By *H. Van Beek, his acct on time*,	7	54	00	00
By *H. Van Beek, his acct-current*,	7	00	00	06
By *James Ward*, due to him, -	8	216	00	00
By *George Kent his acct-proper*, -	9	361	00	00
By *Simon King his acct-proper*, -	10	134	07	04
By *John Oker his acct proper*, -	10	134	07	04
By *Stock*, the neat of my estate, -	2	13474	15	03
		14424	01	05

Of the SUBSIDIARY BOOKS used by MERCHANTS.

THOUGH all merchant-accompts may be kept by the *Waste-book*, *Journal*, and *Ledger*, alone; yet men of great business find it convenient, either for abridging these, or for other ends, to use some others, generally called *subsidiary* or *subservient Books*; the most common of which are these nine following, *viz.*

1. *The Cash-book.*

THIS book is kept in a folio form, like the Ledger, and serves to abridge the Cash-accompt there. On the left-hand page, or Dr side, *Cash* is charged Dr for all the sums received; and on the right-hand page, *Cash* is made Cr for all the sums paid. Once a week, or, which is more ordinary, once a month, this book is posted to the Ledger; or, if you please, first to the Journal, by two entries, *viz.* *Cash* Dr to *Sundries*, for all the receipts, and *Sundries* Drs to *Cash*, for all the payments. By this means the Cash-accompt in the Ledger will be so far contracted as to consist of 12 lines, *viz.* one for each month in the year. A specimen of this book follows.

	1769. *Cash, Dr.*	l.	s.	d.
July 1	To *George Hill*, received in full for lead,	90	00	00
5	To *John Scot*, in part for sugar, -	109	10	00
12	To *Robert Hunter*, for *A. B*'s bill on him,	30	00	00
18	To *Port wine*, received for 1 pipe,	26	10	00
31	To *James Neil and comp.* in full for tobacco,	100	00	00
		356	00	00

	1769. *Contra, Cr.*	l.	s.	d.
July 3	By *George Duncan*, paid in full for canary,	100	00	00
11	By *R. Richmond and Co.* in part for dowlas,	60	00	00
20	By *Samuel Smith*, paid him *R. Blair*'s bill,	10	00	00
25	By *Holland*, for 2 pieces, at 18 *l.* -	30	00	00
31	By *Charges of merchandize*, - -	56	2	02
—	By *House-expences*, - - -	36	00	00
		298	02	02

Note, Merchants that have cash-keepers must beware to write any thing in the Cash-book themselves; for if they do, the cash-keeper is no more accountable for what is stated in the book; and therefore the master, in case of money delivered to him, in the cash-keeper's absence, must keep it till he come home; and then deliver it to him, and see him enter it in the book himself.

2. *The Book of Charges of Merchandize.*

THIS book is only paged, and designed to abbreviate the Cash-book. It contains particular charges on goods and voyages; such as, carriage, custom, freight, cranage, wharfage, *&c.*: As also other expences that affect trade in general; such as, warehouse-rent, shop-rent, accomptant's wages, postage of letters, and the like. At the end of each month the money-columns of this book are added up, and the sum carried to the credit-side of the Cash-book.

N. B. At the same time you post the monthly sums of this book to the Cash book, you must debit the several accompts of goods and voyages for their particular shares of charges; which is done by passing the following entry in the Journal, namely, *Sundries* (*viz.* the several accompts of goods and voyages for their respective shares) Drs to *Charges of merchandize*. The remaining part of these charges will be such as relate to trade in general, being chargeable to no particular accompt, and will of course fall into the general accompt of *Profit and Loss*, when the accompt of *Charges of merchandize* in the Ledger is closed, at balancing the books. The form of this book follows,

	1769. *Charges of Merchandize, Dr.*	l.	s.	d.
July 1	To *Cash*, paid for freight of 10 tuns of iron,	18	00	00
3	To *ditto*, paid custom of *ditto*, - -	20	15	02
8	To *ditto*, paid other petty charges on *ditto*,	0	18	00
12	To *ditto*, paid porterage of goods bought of *A. B.*	0	02	06
—	To *ditto*, paid the stationers for paper, -	2	14	00
18	To *ditto*, paid postage of letters, -	0	10	06
27	To *ditto*, paid rent of 2 cellars, -	3	18	00
31	To *ditto*, paid charges on 12 bales of skins,	9	04	00
		56	02	02

The Book of House-expences.

THIS book is also paged, and designed likewise to ease the Cash-book. It contains all disbursements for family-provisions, servants wages, house-rent, apparel, utensils, *&c.* The money-columns of this book are also added up at the end of each month, and the sum transferred to the credit side of the Cash-book.

N. B. If goods are brought from the shop for the use of the family, this more properly belongs to the Waste book, and is not to be inserted here. A specimen of this book follows.

	1769. *House-expences, Dr.*	l.	s.	d.
July 1	To *Cash*, paid for new cloaths, hat, and shoes,	10	00	06
10	To *ditto*, paid for six drinking-glasses, -	0	00	09
17	To *ditto*, paid for earthen-ware, - -	0	03	00
25	To *ditto*, paid for 12 dozen bottles, -	1	00	00
31	To *ditto*, paid pocket-expences, - -	9	09	00
—	To *ditto*, paid the housekeeper, - -	15	06	09
		36	00	00

4. *The Invoice-book.*

THIS book, which is used chiefly by factors, is paged, and contains doubles or copies of the invoices of goods sent to sea, or of goods received from abroad. The form of an invoice is as follows.

London,

London, 1st July 1769.

Invoice of 8 *boxes indigo, and* 4 *boxes spiceries, shipped per the* Bonadventure, Robert Hay *master, for* Leith, *by order, and for accompt of* A. B. *merchant there.*

		l.	s.	d.
A. B. INDIGO 8 boxes.				
Gross. Tare.				
Nº 1——70¼ : 14½				
2——65 : 13½				
3——80 : 15				
4——67 : 13				
5——75 : 24				
6——57¼ : 12½				
7——64 : 13¼				
8——85¾ : 16				
564¼ 111¾				
111¾				
	l. s. d.			
452¾ lb. neat, at 4*s.* 3*d.*	96 4 2¼			
Boxes, - - -	0 9 4			
		96	13	06¾
SPICERIES 4 boxes.				
lb.	*l. s. d.*			
Nº 1——12 cinnamon, at 7*s.* 9*d.*	4 13 0			
2——4 nutmegs, at 8*s.* 8*d.*	1 14 8			
3——57 pymento, at 8*d.* -	0 15 6			
4——1 mace, - - -	0 15 6			
Boxes, - -	0 4 6			
		[illegible]	05	8
Bill of lading, cocket, and other charges,		0	0	09
		106	0	11¼
Commission at 2½ *per cent.* - - -		2	1	00
Insurance on the above 100*l.* 1½ *per cent.* and policy, 4*s.* 6*d.* is - - -		1	1	06
Commission on *ditto* at ½ *per cent.* - -		0	1[illegible]	00
		111	06	05¼

Errors excepted, *per* M. S.

N. B. When a merchant in *Britain* ships off imported goods, such as tobacco, to *Holland*, or other places, for sale, the invoice sent to the factor usually contains only the marks, numbers, and quantity shipped, but nothing of the prime cost or charges; which in this case could not be easily ascertained; and the want thereof is pretty well supplied by instructing the factor not to sell under such a price. But invoices of all kinds of manufactures and goods consigned from *Britain* to *North America* or the *West Indies*, generally exhibit prime cost and all charges; which is necessary, not only as it serves for a sort of directory to the factor, but still more so, in regard *British* goods are frequently sold in those places at so much advance on the invoice prices.

5. *The Sales-book.*

This book too is chiefly used by factors; and into it is posted, from the Waste-book, the particular sales of every consigned cargo; by which means the several articles of a sale, that lie scattered in the Waste-book, are brought together, and represented under one view, and th[illegible] in a manner more full and minute than they are collected in the Ledger accompt. This book exhibits the sales of every consignment separately and by themselves; to which are subjoined the respective charges, such as freight, custom, the factor's commission, as also abatements allowed to buyers, *&c.* whose sum subtracted from the gross amount of sales, gives the neat proceeds. From this book, when a cargo is sold off, an accompt of sales is drawn out, in order to be transmitted to the employer. If the consignment consist but of one kind of goods, the Sales-book may be ruled and written up as in the following example.

Rotterdam, 1st June 1765.

Sales of 6 *packs serges, containing* 4380 *yards, received per the* Friendship, Samuel Sharp *master, for account of* A. B. *merchant in* Glasgow, North Britain.

1769				Guil.	St	D.
June	2	Sold *Frederick Gordon*, at 1 month,				
		Packs. Pieces. Yards.				
		Nº 1——19——743				
		4——20——643				
		——1386 at 7 stivers.		48[illegible]	02	00
	29	Sold for ready money,				
		Nº 2——17——717				
		3——18——730				
		5——14——830				
		6——16——717				
		——2994 at 6 stivers		8[illegible]	[illegible]	00
		Total 4380		13[illegible]	06	00
		CHARGES.				
			G. St. D			
		Freight and average, -	25 10 00			
		Custom and waiters dues, -	31 00 0			
		Scout-freight, and other small charges, - -	3 00 00			
		Measuring, at 4 stivers *per* 100 yards, - -	8 14 00			
		Charges in selling, and pack-house-rent, - -	4 04 0			
		Commission, at 2 *per cent.*	27 13 00			
				[illegible]	01	00
		Neat proceeds, (errors and bad debts excepted,) carried to the credit of his *Accompt-current*, - -		1283	05	00

If the consigned cargo consists of two or more kinds of goods, the *Sales book* must be ruled with columns for the different sorts of goods; and the heads of these columns must be titled with the names and quantities of the goods from the invoice.

6. *The Bill-book.*

The design of this *Bill-book*, or *Month-book*, is to furnish a merchant with a ready way of knowing the time when bills or other debts become payable to or by him. It consists of 12 folios, one for each month in the year. The left-hand page contains the debts that fall due to the merchant in the month on the top, and the right-hand page contains the debts payable by him to others in the same month; as in the annexed specimen.

	———1769.———	l.	s.	d.
Days	*January, to receive.*			
1	Of *Edward Finch*, 600 crowns, at 54*d.* bill,	135	00	00
10	Of *Robert Banks*, for lintseed, -	86	10	00
23	Of *George Hally*, for *Norwich* stuffs,	35	00	00
31	Of *John Short*, 2539 guilders, 19 stivers, at 34*s.* 5*d.* *Flemish per L. Sterling*,	246	00	00

Days

Days	1769. January, to pay.	*l.*	*s.*	*d.*
3	To *Simon Smith*, 3000 crowns, at 56 *d.* bill of *G. F.* - - -	70	00	00
12	To *James Jeffery*, for ſundry goods,	68	13	04
25	To *James Martin* and company,	125	00	00
30	To *James Halley*, for oil, - -	76	09	10

N. B. Upon the payment of any ſum, merchants either cancel the line, or, which is better, they write the word *Received* or *Paid* upon the margin, or uſe ſome mark of their own, to ſignify that the ſum to which it is affixed is paid.

7. *The Receipt-book.*

In this book a merchant takes receipts of the payments he makes. The receipt ſhould contain the date; the ſum received, expreſſed in words at large, and alſo in figures in the money-columns; the reaſon why; and whether in full or in part; and muſt be ſigned by the perſon receiving. But there is no occaſion to mention the merchant's name; for the book being his own, ſufficiently implies that. This book is paged, and the form of it is as follows.

	l.	*s.*	*d.*
Received, *July* 1. 1769, in part for ſugar, the ſum of one hundred thirty ſix pounds, per *John Stewart.*	136	00	00
Received, this 4th of *July* 1769, in full for indigo, the ſum of forty eight pounds ten ſhillings, - - - - per *Tho. Green.*	48	10	00
Received, *July* 6. 1769, in part for lead, twenty pounds, for my maſter *David Douglas*, per *Sam. Sprat.*	20	00	00
Received, *July* 10. 1769, in full for coperas, thirty ſix pounds twelve ſhillings, for ſelf and company, - - - Per *David Duff.*	36	12	00
Received, *July* 11. 1769, forty-five pounds twelve ſhillings and nine pence, in full for tobacco ſold the 10th of January laſt, for ſelf and partner, - - Per *Simon Truſty.*	45	12	09
Received, *July* 12. 1769, the ſum of fifty pounds, by order, and for the account of *George Grant*, - - - Per *Nath. Smith.*	50	00	00

8. *The Copy-Book of Letters.*

It is very imprudent in any perſon to ſend away a letter of buſineſs, without keeping a double of it to himſelf; and therefore, to prevent the bad conſequences of ſuch a careleſs practice, merchants are provided with a large book, in *folio*, into which is copied *verbatim* every letter of buſineſs before it be ſent off. So that this book, together with the letters received (which muſt alſo be carefully kept in files or boxes,) makes a complete hiſtory of all the dealings that paſs betwixt a merchant and his correſpondents; which may be very uſeful and neceſſary on many occaſions.

9. *The Pocket-book.*

This is a ſmall book, of a portable ſize, which a merchant carries in his pocket when buſineſs calls him abroad to a tavern, a fair, the country, or other places. In this he ſets down the bargains he makes, the expences he is at, the debts he pays, or ſums he receives, with every other part of buſineſs he tranſacts while abroad; as alſo any occurrence or piece of news he thinks worth while to record. And when he comes home to his compting-houſe or ſhop, he transfers the things contained in this book, each to their proper places in the Waſte-book, or Books Subſidiary.

Factors of great buſineſs ſometimes keep another ſmall book, called the *Memorandum book.* Into this book is copied, from letters as they come to hand, ſhort notes of the ſeveral commiſſions for buying goods contained in them; and as the commiſſions are effected, the notes are croſſed, or have ſome mark affixed to them. This is more convenient in doing buſineſs, than to be continually running to the letters themſelves. Suppoſe a merchant of Liſbon, by his letter, give a commiſſion for buying goods, a note of it in the Memorandum book will ſtand thus.

Liſbon, 15th June 1769.

Out of *Carlos Popham*'s letter an order for 4000 yards of ſerges, at 8 *d.* or $8\frac{1}{2}$ *d. per* yard, 20 dozen ſtockings, not above 36 *s. per* dozen, *&c.*

All which to be packed and ſhipped for Liſbon, conſigned to himſelf, and marked *C. P.*

In like manner factors may, and thoſe much employed generally do, take a note, from the letters of advice, of all the goods conſigned to them, either in a ſeparate place of this book, or in another book of the ſame nature. By this means a factor has daily under his eye, both the time when ſuch a ſhip may be expected, and the goods ſhe brings: And ſo is in a readier way of minding to look out for a merchant for them before-hand, than if he had only the letter as his remembrancer. An example follows.

Naples, 18th June 1769.

In the *Proſperity*, *Robert Wilſon* maſter, ſilks for account of *Anthony Carew*, marked *A. C.* N° 122 to 140.

The above are the ſubſidiary books moſt in uſe: But a merchant is not tied down or reſtricted to them; he may keep ſome, and neglect others, or invent more, as the nature of his buſineſs requires, and he finds convenient.

Addendum

Addendum to the article Book.

All foreign bound books pay duty on importation 14s. for every 112 lb. As to unbound books, they are commonly entered by the hundred weight, and pay, if French, 13 s. 6$\frac{45}{100}$ d. but if from any other country, only 7s. 7$\frac{20}{100}$d. It is alſo to be obſerved, that all popiſh books are prohibited to be imported; as are all Engliſh books printed abroad, unleſs with the conſent of the proprietor of the copy.

Common-place-Book. See Common-*place-book*.

Text-Book. See Text.

Book *binding*. The art of gathering and ſewing together the ſheets of a book, and covering it with a back, *&c.* It is performed thus: The leaves are firſt folded with a folding-ſtick, and laid over each other in the order of the ſignature; then beaten on a ſtone with a hammer, to make them ſmooth and open well, and afterwards preſſed. They are ſewed upon bands, which are pieces of cord or packthread; ſix bands to a folio book, five to a quarto; octavo, *&c.* which is done by drawing a thread through the middle of each ſheet, and giving it a turn round each band, beginning with the firſt, and proceeding to the laſt. After this the books are glued, and the bands opened and ſcraped, for the better fixing the paſteboards; the back is turned with a hammer, and the book fixed in a preſs between two boards, in order to make a groove for fixing the paſteboards; theſe being applied, holes are made for fixing them to the book, which is preſſed a third time. Then the book is at laſt put to the cutting preſs, betwixt two boards, the one lying even with the preſs, for the knife to run upon, the other above it, for the knife to run againſt: After which the paſte-boards are ſquared.

The next operation is the ſprinkling the leaves of the book, which is done by dipping a bruſh into vermilion and ſap-green, holding the bruſh in one hand, and ſpreading the hair with the other; by which motion the edges of the leaves are ſprinkled in a regular manner, without any ſpots being bigger than the others.

Then remains the covers, which are either of calfſkin, or of ſheep-ſkin; theſe being moiſtened in water, are cut out to the ſize of the book, then ſmeared over with paſte made of wheat flour, and afterwards ſtretched over the paſteboard on the outſide, and doubled over the edges withinſide; after having firſt taken off the four angles, and indented and platted the cover at the head-band: which done, the book is covered, and bound firmly between two bands, and then ſet to dry Afterwards it is waſhed over with a little paſte and water, and then ſprinkled fine with a bruſh, unleſs it ſhould be marbled; when the ſpots are to be made larger, by mixing the ink with vitriol. After this the book is glazed twice with the white of an egg beaten, and at laſt poliſhed with a poliſhing-iron paſſed hot over the glazed cover.

BOOKSELLER, one who trades in books, whether he prints them himſelf, or gives them to be printed by others.

Bookſellers are in many places ranked among the members of univerſities, and entitled to the privilege of ſtudents, as at Tubingen, Saliſburg, and Paris, where they have always been diſtinguiſhed from the vulgar and mechanical traders, and exempted from divers taxes and impoſitions laid upon other companies.

The traffic of books was anciently very inconſiderable, in ſo much, that the book-merchants of England, France, and Spain, and other countries, were diſtinguiſhed by the appellation of *ſtationers*, as having no ſhops, but only ſtalls and ſtands in the ſtreets. During this ſtate, the civil magiſtrates took little notice of the bookſellers, leaving the government of them to the univerſities, to whom they were ſuppoſed more immediate retainers; who accordingly gave them laws and regulations, fixed prices on their books, examined their correctneſs, and puniſhed them at diſcretion.

But when, by the invention of printing, books and bookſellers began to multiply, it became a matter of more conſequence, and the ſovereigns took the direction of them into their own hands; giving them new ſtatutes, appointing officers to fix prices, and granting licences, privileges, *&c.*

BOOKING, among merchants, the making an entry of any thing in a Journal. See Book-keeping.

BOOM, in the ſea-language, a long piece of timber with which the clew of the ſtudding-ſail is ſpread out; and ſometimes the boom is uſed to ſpread or boom out the clew of the mainmaſt.

Boom-ſpars, imported from the Britiſh plantations, are free; if from Ireland, Aſia, or Africa, they pay 6s. 5d. the hundred; and if from elſewhere, 9s. 6½d.

Boom denotes alſo a cable ſtretched athwart the mouth of a river or harbour; with yards, topmaſts, battling or ſpars of wood laſhed to it, to prevent an enemy's coming in.

BOOMING, among ſailors, denotes the application of a boom to the ſails.

A ſhip is ſaid to come booming forwards, when ſhe comes with all the ſail ſhe can make.

BOOPHTHALMUS, a kind of agat with large circles in it, bearing ſome reſemblance to an ox's eye, from whence it has got this name.

BOOPS, in zoology, the trivial name of a ſpecies of balæna. See Balæna.

BOOT, a well known cover for the leg, made of leather.

Boot-*tree*, or Boot-*laſt*, an inſtrument uſed by ſhoemakers to widen the leg of a boot. It is a wooden cylinder ſlit into two parts, between which, when it is put into the boot, they drive by main force a wedge or quoin.

BOOTES, a conſtellation of the northern hemiſphere, conſiſting of 23 ſtars, according to Ptolemy's catalogue, of 18 in Tycho's, of 34 in Bayer's, of 52 in Helvelius's, and of 54 in Mr Flamſtead's catalogue. See Astronomy, p. 486.

BOOTY, whatever is taken from an enemy in time of war.

BOPPART, a town of the electorate of Triers, ſituated on the weſt ſhore of the Rhine, about eight miles ſouth of Coblentz: E. long. 7° 10′, N. lat. 50° 20′.

BOQUEROON, an iſland in the E. Indian ocean, lying north-eaſt of Borneo, in N. lat. 3°.

BOQUINIANS, in church-hiſtory, a ſect of heretics, ſo called from Boquinus their founder, who taught that Chriſt did not die for all mankind, but only for the faithful, and conſequently was only a particular Saviour.

BORA, in natural hiſtory, a name uſed by ſome for the Bufonites. See BUFONITES.

BORAGO, in botany, a ſynonime of the anchuſa. See ANCHUSA.

BORAK, a fabulous animal, ſaid to be of a middle nature between an aſs and a mule, and to have carried Mahomet in his aerial journeys from Jeruſalem into heaven.

BORASSUS, in botany, a genus belonging to the order of palmæ flabellifoliæ. The boraſſus, of which there is but one ſpecies, has palmated and plaited leaves, and is a native of India.

BORAX, the name of a ſaline ſubſtance brought from the E. Indies in large maſſes, compoſed partly of large cryſtals, but chiefly of ſmaller ones, partly white and partly green, joined together, as it were, by a greaſy yellow ſubſtance, intermingled with ſand, ſmall ſtones, and other impurities. The purer cryſtals, expoſed to the fire, melt into a kind of glaſs, which is nevertheleſs ſoluble in water.

This ſalt, diſſolved and cryſtalized, forms ſmall tranſparent maſſes. The origin of this ſalt is not known; but experiments have clearly ſhewn, that it conſiſts of a fixt alkaline ſalt, the ſame with the baſis of ſea-ſalt, in ſome degree neutraliſed by another ſaline ſubſtance, which is ſuppoſed to exiſt no where but in borax itſelf.

The medical virtues of borax are little known: In doſes of half a dram to two ſcruples, it is ſuppoſed to be diuretic, emmenagogue, and a promoter of delivery.

BORBONIA, in botany, a genus of the diadelphia decandria claſs. The calix is pointed and prickly; and the ſtygma is emarginated. There are ſix ſpecies of borbonia, which is a kind of broom, all natives of America

BORBORITES, in church-hiſtory, a ſect of gnoſtics, in the ſecond century, who, beſides embracing the errors of theſe heretics, denied the laſt judgment.

Their name comes from the Greek, [*Borboros*], *filth*, on account of a cuſtom they had of daubing their faces and bodies with dirt and filth.

BORCH, a town of lower Saxony, in Germany, about fourteen miles north-eaſt of Magdeburg: E. long. 12° 14′, N. lat. 52° 25′.

BORCHLEON, or LOOTS, a town of the biſhopric of Liege in Germany, about fifteen miles north-weſt of the city of Liege: E. long. 5° 30′, N. lat. 50° 50′.

BORDAT, in commerce, a ſmall narrow ſtuff, which is manufactured in ſome parts of Egypt, particularly at Cairo, at Alexandria, and Damieta.

BORDER, in gardening, is made to incloſe parterres, that they may not be injured by walking in them.

Borders are made either circular, ſtrait, or in cants; and are turned into knots, ſcrolls, volutes, and other compartiments. They are rendered very ornamental by the flowers, ſhrubs, yews, *&c.* that are raiſed in them. They are always laid with a ſharp riſing in the middle; becauſe, if they are flat, they are noways agreeable to the eye: And as for their breadth, the largeſt are allowed five or ſix feet, and the leſſer commonly four. There are four ſorts, 1. Thoſe continued about parterres, without any interruption. 2. Thoſe cut into compartiments and convenient diſtances by ſmall paſſages; theſe two are raiſed in the middle, and adorned with flowers and ſhrubs. 3. Even and flat ones, without flowers. And, 4. Quite plain borders, only ſanded, as in parterres of orangery.

BORD-*free*. See FREE.

BORD-*halfpenny*, a ſmall toll, by cuſtom paid to the lord of the town for ſetting up boards, tables, booths, *&c.* in fairs and markets.

BORD-*lands*, the demeſnes which lords keep in their hands for the maintenance of their board or table.

BORD-*lode*, a ſervice required of tenants to carry timber out of the woods of the lord to his houſe. It is alſo uſed to ſignify the quantity of proviſion which the bordarii or bordmen paid for their bord lands.

BORD-*ſervice*, the tenure of bord-lands, by which ſome lands in certain places are held of the biſhop of London, and the tenants now pay ſixpence *per* acre, in lieu of finding proviſion anciently for their lord's table.

BORDURE, in heraldry, a cutting off from within the eſcutcheon all round it about $\frac{1}{5}$ of the field, ſerving as a difference in a coat of arms, to diſtinguiſh families of the ſame name, or perſons bearing the ſame coat. See Plate LI. fig. 16.

If the line conſtituting the bordure be ſtrait, and the bordure be plain, then in blazoning you muſt only name the colour of the bordure.

Bordures are ſometimes ingrailed, gobonated, invicted, *&c.* See INGRAILED, *&c.*

If the border be charged with any part of plants or flowers, the term is verdoy of trefoils, or whatever flower it be. If it conſiſts of ermins, vairy, or any of the furs, they ſay purflew of ermins, *&c.* If the bordure be charged with martlets, the word is charged with an enalyron of martlets, *&c.*

Bordures are ſymbols of protection, favour and reward; and as ſuch kings beſtow them on thoſe they have a value for.

BORE, among engineers, denotes the diameter of the barrel of a gun or cannon, or rather its whole cavity.

Square BORE, among mechanics, a ſquare piece of well-tempered ſteel, fitted into a handle, ſerving to widen holes, and make them perfectly round.

BOREAL, in a general ſenſe, ſomething relating to the north. Thus,

BOREAL *ſigns*, in aſtronomy, are the firſt ſix ſigns of the zodiac, or thoſe northwards of the equinoctial.

Aurora BOREALIS. See PNEUMATICS.

BOREAS, a Greek name, now in common uſe for the north wind.

Pezron obſerves, that anciently boreas ſignified the north-eaſt wind, blowing at the time of the ſummer ſolſtice.

folftice. Boreas is represented in painting like an old man with a horrible look, his hair and beard covered with fnow or hoar froft, with the feet and tail of a ferpent.

BOREASMI, in Grecian antiquity, a feftival kept by the Athenians in honour of Boreas.

BOREEL, a cape on the north part of New Zeland, in the South Sea, lying weft by fouth from the moft foutherly part of South America.

BORGO, a town of Finland, in the province of Nyland, upon the northern coaft of the gulph of Finland.

Borgo di Sesia, a town of Italy, in the dutchy of Milan, fituated upon the Sefia.

Borgo de St Sepulchro, a town of Tufcany, about fifty miles eaft of Florence, near the head of the Tiber; E. long. 13°, and N. lat 43° 30′.

Borgo de Val de Faro, a town of Italy, in the dutchy of Parma, about twenty miles fouth-weft of that city; E. long. 10° 36′, and N. lat. 44° 35′.

Borgo-Forte, a town of the Mantuan, in Italy, fituated at the confluence of the rivers Po and Menzo, about eight miles fouth of Mantua; E. long. 11° N. lat. 44° 5′.

Borgo St Domingo, a city of Italy, in the dutchy of Parma, about ten miles north-weft of that city; E. long. 10° 31′, N. lat. 44° 50′.

BORIA, a city of Arragon, in Spain, about thirty-five miles north-weft of Saragoffa; W. long. 2°, and N. lat. 41° 40′.

BORING, in a general fenfe, the art of perforating, or making a hole through any folid body.

Boring *of water-pipes*. The method of boring water-pipes is as follows. The poles of alder, which is a very ufeful wood in making pumps, water-pipes, *&c.* being laid on horfes or treffels of a foot height, to reft the auger upon while they are boring, they fet up a lath to turn the leaft end of the poles, to fit them to the cavities of the great end of the others. They turn the fmall ends of the poles about five or fix inches in length, to the fize they intend to bore the bigger ends about the fame depth, *viz.* five or fix inches. This is defigned to make a joint to fhut each pair of poles together, the concave part being the female part, and the other part the male of the joint. In turning the male part, they turn a channel in it, or a fmall groove at a certain diftance from the end; and in the female part, they bore a fmall hole to fit over this channel. This being done, they bore the poles through; and to prevent them from boring out at the fide, they ftick great nails at each end to be a guide in boring. It is ufual, however, to bore them at both ends; fo that if a pole be crooked one way, they can bore it through, and not fpoil it.

Boring, in farriery, an operation in ufe for the cure of wrenched fhoulders in horfes. It is this; having cut a hole in the fkin, over the part affected, they blow it with up a tobacco-pipe, as a butcher does a fhoulder of veal; after which they thruft a cold flat iron, like the point of a fword-blade, eight or ten inches up between the fhoulder-blade and the ribs: This they call boring.

Boring, in mineralogy, a method of piercing the earth with fcooping irons, which being drawn back at proper times, bring up with them famples of the different ftrata through which they have paffed; by the examination of which the fkilful mineralift will be able to guefs whereabouts a vein of ore mayl ie, or whether it will be worth while to open a mine there or no.

BORIQUE, one of the Caribbee iflands, lying fouth-eaft of Porto Rico, in 64° 30′ W. long. and 18° N. lat.

BORISSOW, a town of Poland, in the dutchy of Lithuania, fituated upon the river Berozina.

BORISTHENES, in geography. See Nieper.

BORITH. See Kali.

BORMIO, a territory of the Grifons, in Italy, having the dominions of Venice on the fouth.

BORNE, a market-town in Lincolnfhire, about 30 miles fouth of the city of Lincoln; in 20′ W. long. and 52° 40′ N. lat.

BORNEO, a large ifland in the Indian ocean, fituated between 107° and 117° E. long. and between 7° 30′ N. lat. and 4° S. lat.

Its figure is almoft round, and computed to be 2500 miles in circumference, and confequently containing a greater number of fquare acres than any ifland in the known world.

Borneo is alfo the name of the principal town of the above ifland, fituated on a bay at the north-weft part, in 111° 30′ E. long. and 4° 30′ N. lat.

BORNHOLM, an ifland in the Baltic Sea, fituated on the coaft of Schonen, in Sweden, about 43 miles north-eaft of the ifland of Rugen, in 15° E. long. and 55° 15′ N. lat.

BORNEO, or Bournou, the name of a town and country of Nigritia, in Africa. This country abounds in cattle, millet, and cotton. It lies between 15° and 24° E. long. and between 10° and 20° N. lat.

Borneo is alfo the name of a lake, in the river Niger, where it traverfes the above-mentioned country.

BOROUGH, in Scots law, is a body corporate made up of the inhabitants of a certain tract of ground erected by the fovereign, and endowed with a limited jurifdiction, and certain privileges. They are divided into boroughs royal, of regality, and of barony. See Law, tit. *Inferior Judges and Courts of Scotland.*

Borough-english, a cuftomary defcent of lands or tenements, in certain places, by which they defcend to the youngeft inftead of the eldeft fon; or, if the owner have no iffue, to the younger inftead of the elder brother. This cuftom goes with the land, although there be a devife or feoffment at the common law to the contrary. The reafon of this cuftom, fays Littleton, is, becaufe the youngeft is prefumed in law to be leaft able to provide for himfelf.

Borough-head, or Headborough, called alfo borough-holder, or burfholder, the chief man of the *decenna*, or hundred, chofen to fpeak and act in behalf of the reft.

Headborough alfo fignifies a kind of head conftable, where there are feveral chofen as his affiftants, to ferve warrants, *&c.* See Constable.

BOROUGH-BRIDGE, a town in the North Riding of Yorkshire, about 15 miles norh-west of York; in 1° 15′. W. long. and 54° 10′ N. lat.

BOROZAIL, or the zail of the Ethiopians, a disease epidemic in the countries about the river Senega. It principally affects the pudenda, but is different from the lues venerea. It owes its rise to excessive venery: In the men this distemper is called *asab*, and in the women *assabatus*.

BORRAGE. See ANCHUSA.

BORRELLISTS, in church-history, a Christian sect in Holland. They reject the use of churches, of the sacraments, public prayer, and all other external acts of worship. They assert, that all the Christian churches of the world have degenerated from the pure apostolical doctrines, because they have suffered the word of God, which is infallible, to be expounded, or rather corrupted, by doctors, who are not infallible. They lead a very austere life, and employ a great part of their goods in alms.

BORSALO, a kingdom of Africa, in Nigritia: It extends along the north side of the river Gambia, as far as Tantaconde.

BOS, in zoology, a genus of quadrupeds belonging to the order of pecora. The characters of this genus are taken from the horns and teeth. The horns are hollow within, and turned forward, in the form of crescents: There are eight fore-teeth in the under jaw, and none in the upper, their place being supplied by a hard membrane; and there are no dog-teeth in either jaw. Linnæus enumerates six species, *viz.* 1. The taurus, including the bull and cow, has cylindrical horns, bent outwards, and loose dewlaps. The bull or male is naturally a fierce and terrible animal. When the cows are in season, he is perfectly ungovernable, and often altogether furious. When chaffed, he has an air of sullen majesty, and oft tears up the ground with his feet and horns. The principal use of the bull is to propagate the species; although he might be trained to labour, his obedience cannot be depended on. A bull, like a stallion, should be the most handsome of his species. He should be large, well made, and in good heart; he should have a black eye, a fierce aspect, but an open front; a short head; thick, short, and blackish horns, and long shaggy ears; a short and straight nose, large and full breast and shoulders, thick and fleshy neck, firm reins, a streight back, thick fleshy legs, and a long tail well covered with hair. Castration remarkably softens the nature of this animal; it destroys all his fire and impetuosity, and renders him mild and tractable, without diminishing his strength; on the contrary, after this operation, his weight is increased, and he becomes fitter for the purposes of plowing, *&c.*

The best time for castrating bulls is at the age of puberty, or when they are eighteen months or two years old; when performed sooner, they often die. However, it is not uncommon to castrate calves a few days after birth. But such as survive an operation so dangerous to their tender age, generally grow larger and fatter, and have more courage and activity than those who are castrated at the age of puberty. When the operation is delayed till the age of six, seven, or eight years, they lose but few of the qualities of bulls, are much more furious and untractable than other oxes, and when the cows are in season, they go in quest of them with their usual ardor. See Plate LII. fig. 2.

The females of all those species of animals which we keep in flocks, and whose increase is the principal object, are much more useful than the males. The cow produces milk, butter, cheese, *&c.* which are principal articles in our food, and besides answer many useful purposes in various arts.

Cows are generally in season, and receive the bull, from the beginning of May to the middle of July. Their time of gestation is nine months, which naturally brings the veal or calves to our markets from the beginning of January to the end of April. However, luxury has fallen upon methods of interrupting this natural course, and veal may be had almost every month in the year.

Cows, when improperly managed, are very subject to abortion. In the time of gestation, therefore, they ought to be observed with more than ordinary care, lest they should leap ditches, *&c.* Neither should they be suffered to draw in the plough or other carriage, which is a practice in some countries. They should be put into the best pasture, and should not be milked for six weeks or two months before they bring forth their young. The calve should be allowed to suck and follow its mother during the first six or eight days. After this it begins to eat pretty well, and two or three sucks in a day will be sufficient. But if the object be to have it quickly fattened for the market, a few raw eggs every day, with boiled milk, and a little bread, will make it excellent veal in four or five weeks. This management of calves applies only to such as are designed for the butcher. When they are intended to be nourished and brought up, they ought to have at least two months suck; because the longer they suck, they grow the stronger and larger. Those that are brought forth in April, May, or June, are the most proper for this purpose; when calved later in the season, they do not acquire sufficient strength to support them during the winter.

The cow comes to the age of puberty in 18 months, but the bull requires two years: But although they are capable of propagating at these ages, it is better to restrain them till they be full three years. From three to nine years those animals are in full vigour; but when older, they are fit for nothing but to be fed for the butcher. A milk cow ought to be chosen young, fleshy, and with a brisk eye.

The heaviest and most bulky animals neither sleep so profoundly, nor so long as the smaller ones. The sleep of the ox is short and slight; he wakes at the least noise. He lies generally on the left side, and the kidney of that side is always larger than the other. There is great variety in the colour of oxen. A reddish or black colour is most esteemed. The hair should be glossy, thick, and soft; for, when otherwise, the animal is either not in health, or has a weakly constitution. The best time for

inuring

inuring them to labour is at the age of two and a half or three years.

The ox eats very quick, and ſoon fills his firſt ſtomach; after which he lies down to ruminate, or chew the cud. The firſt and ſecond ſtomachs are continuations of the ſame bag, and very capacious. After the graſs has been chewed over again, it is reduced to a kind of maſh, not unlike boiled ſpinage, and under this form it is ſent down to the third ſtomach, where it remains and digeſts for ſome time; but the digeſtion is not fully compleated till it comes to the fourth ſtomach, from which it is thrown down to the guts. The contents of the firſt and ſecond ſtomachs are a collection of graſs and other vegetables roughly macerated; a fermentation however ſoon commences, which makes the graſs ſwell. The communication between the ſecond and third ſtomach is by an opening much ſmaller than the gullet, and not ſufficient for the paſſage of the food in this ſtate. Whenever then the two firſt ſtomachs are diſtended with food, they begin to contract, or rather perform a kind of re-action. This re-action compreſſes the food, and makes it endeavour to get out: Now the gullet being larger than the paſſage between the ſecond and third ſtomachs, the preſſure of the ſtomach neceſſarily forces it up the gullet. The action of ruminating, however, appears to be in a great meaſure voluntary; as animals of this kind have a power of increaſing the re-action of their ſtomachs. After the food undergoes a ſecond maſtication, it is then reduced into a thin pulp, which eaſily paſſes from the ſecond to the third ſtomach, where it is ſtill further macerated; from thence it paſſes to the fourth, where it is reduced to a perfect mucilage, every way prepared for being taken up by the lacteals, and converted into nouriſhment. What confirms this account of chewing the cud is, that as long as theſe animals ſuck or feed upon liquid aliment, they never ruminate; and in the winter, when they are obliged to feed upon hay and other dry victuals, they ruminate more than when they feed upon freſh graſs.

Bulls, cows, and oxen, are fond of licking themſelves, eſpecially when lying at reſt. But this practice ſhould be prevented as much as poſſible; for as the hair is an undigeſtible ſubſtance, it lies in the ſtomach or guts, and is gradually coated by a glutinous ſubſtance, which in time hardens into round ſtones of a conſiderable bulk, which ſometimes kills them, but always prevents their fattening, as the ſtomach is rendered incapable of digeſting the food ſo well as it ought.

The age of theſe animals may be diſtinguiſhed by the teeth and horns. The firſt fore-teeth fall out at the age of ſix months, and are ſucceeded by others of a darker colour, and broader. At the end of ſixteen months, the next milk-teeth likewiſe fall out; and at the beginning of the fourth year all the fore-teeth are renewed, and then they are long, pretty white, and equal: However, as the animal advances in years, they become unequal and blackiſh. At the end of three years, the horns of oxen fall off, and new ones ariſe, which continue as long as they live. The horns of oxen four years of age are ſmall pointed, neat, and ſmooth, but thickeſt near the head: This thick part next ſeaſon is puſhed further from the head by a horny cylinder, which is alſo terminated by another ſwelling part, and ſo on, (for as long as the ox lives, the horns continue to grow); and theſe ſwellings become ſo many annular knots by which the age may eaſily be reckoned: But, from the point to the firſt knot muſt be counted three years, and every ſucceeding knot only one year.

Ox-beef is very nouriſhing, and yields a ſtrong aliment; the fleſh of a cow, when well fatted and young, is not much inferior. Bull-beef is hard, tough, and dry; for which reaſon it is not much uſed for food. Veal is well taſted, eaſy of digeſtion, and rather keeps the body open as otherwiſe.

The northern countries of Europe produce the beſt cattle of this kind. In general, they bear cold better than heat; for this reaſon, they are not ſo plenty in the ſouthern countries. There are but few in Aſia to the ſouth of Armenia, or in Africa beyond Egypt and Barbary. America produced none till they were carried there by the Europeans. But the largeſt are to be met with in Denmark, Podolia, the Ukrain, and among the Calmuck Tartars; likewiſe thoſe of Ireland, England, Holland, and Hungary, are much larger than thoſe of Perſia, Turkey, Greece, Italy, and Spain; but thoſe of Barbary are leaſt of all. In all mountainous countries, as Wales, the Highlands of Scotland, the black cattle are exceedingly ſmall, but hardy, and when fattened make excellent beef. In Lapland, they are moſtly white, and many of them want horns. The bull, cow, and ox, generally live about 14 or 15 years.

2. The bonaſus, has a long main; its horns are bent round towards the cheek, and not above a ſpan in length. It is about the ſize of a large bull, and is a native of Africa and Aſia. When enraged, he throws out his dung upon dogs or other animals that annoy him; the dung has a kind of cauſtic quality which burns the hair off any animal it falls upon.

3. The biſon, has likewiſe a long thick mane, which covers the whole neck and breaſt on each ſide. The horns are turned upwards, and exceedingly large; there is a large protuberance or bunch on the back; his eyes are red and fiery, which gives him a furious aſpect. He is fierce, cruel, and ſo bold that he fears nothing. It is unſafe to hunt him but where the trees are large enough to hide the hunters. He is a native of Mexico and Florida.

4. The grunniens, or hog-cow, has cylindrical horns, bent backwards. The body is ſo hairy, that the hair hangs down upon its knees like a goat. The tail has a kind of mane on each ſide. The colour of the body is black; but the front is white. It has briſtles on its back, tail, and hind-legs. It is an inhabitant of the North of Aſia.

5. The bubalis, or buffalo, has large black horns bent backward and inward, and plain before. The hair on the back is very hard, but thinly ſcattered over the body. It is a native of Aſia. But they are tamed in Italy, and uſed for the ſame purpoſes as black cattle in other countries. They draw carriages, and are guided by

by a rope tied to a ring thruſt through their noſes. The buffalo is larger than an ox, has a thicker body, and a very hard hide. His pace is ſlow; but he will carry a great burden. They feed in herds like cows, and yield plenty of milk, of which very good butter and cheeſe is made. Their fleſh is pretty good, but not to be compared to beef. The wild buffalo is a very fierce and dangerous animal; he often attacks travellers, and tears them to pieces. However, they are not ſo much to be feared in woods as in the plains; becauſe their horns, which are ſometimes ten feet long, are apt to be entangled in the branches of trees, which gives thoſe who are ſurpriſed by them time to eſcape. They are excellent ſwimmers, and will croſs the largeſt river without any difficulty. They run wild in great troops on the coaſt of Malabar, for which reaſon ſtrangers are allowed to hunt and kill them at pleaſure.

6. The indicus, or little Indian buffalo, has horns ſhorter than its ears, a bunch on its back, and no mane. It is about the ſize of a calf ſix months old, and uſed in the Eaſt Indies for drawing coaches, *&c.*

BOSA, or Bossa, a town of Sardinia, ſituated on its weſtern coaſt, at the mouth of a river of the ſame name; in 8° 30′ E. long. and 40° 15′ N. lat.

BOSCAGE, the ſame with a grove, or thicket.

Boscage, in a law ſenſe, is that food which trees yield to cattle, as maſt, *&c.* But Manwood ſays, to be quit of boſcage, is to be diſcharged of paying any duty for wind-fall wood in the foreſt.

Boscage, among painters, denotes a landſcape repreſenting much wood and trees.

BOSCHETTO, in geography, a territory in the iſle of Malta: And likewiſe an eſtate belonging to the grand maſters of that order, about two miles from Civita Vecchia, in Italy.

BOSEA, in botany, a genus of the pentandria digynia claſs. The calix conſiſts of five leaves; it has no corolla; and the fruit is a dry, compreſſed, membranaceous berry. There is but one ſpecies, *viz.* the yervamora, a native of the Carribbee-iſlands.

BOSNA-SERAJO, the capital of the province of Boſnia, in 19° E. long. and 44° N. lat.

BOSNIA, a frontier province of Chriſtendom, divided between the Houſe of Auſtria and the Turks; that part of it lying eaſtward of the river Unna, belonging to the Turks; and the reſt of it, lying weſtward of that river, to the Auſtrians.

BOSPHORUS, in geography, denotes, in general, a narrow ſea, or channel, ſeparating two continents, and ſerving as a communication between two ſeas.

Bosphorus is more particularly uſed for the ſtraits of Conſtantinople, which divides Europe from Aſia.

This was the original Boſphorus; ſo called becauſe oxen could ſwim over it: And from the reſemblance between it and the ſtreights of Kaffa, theſe laſt were anciently called the *Cimmerian*, as the former were the *Thracian Boſphorus.*

BOSQUETS, in gardening, groves ſo called from *boſchetto*, an Italian word, which ſignifies a little wood. They are compartments in gardens, formed by branches of trees, diſpoſed either regularly in rows, or wildly and irregularly, according to the fancy of the owner. A boſquet is either a plot of ground incloſed with paliſadoes of horn-beam, the middle of it being filled with tall trees, as elm or the like, the tops of which make a tuft or plume; or it conſiſts of only high trees, as horſe-cheſnut, elm, *&c.* The ground ſhould be kept very ſmooth and rolled, or elſe covered with graſs, after the manner of green-plots. In planting boſquets, care ſhould be taken to mix the trees which produce their leaves of different ſhapes, and various ſhades of green, and hoary or meally leaves, ſo as to afford an agreeable proſpect. Boſquets are only proper for ſpacious gardens, and require a great expence to keep them up.

BOSS, or Bosse, in ſculpture. See Relievo.

BOSSAGE, in architecture, a term uſed for any ſtone that has a projecture, and is laid rough in a building, to be afterwards carved into mouldings, capitals, coats of arms, *&c.*

Boſſage is alſo that which is otherwiſe called ruſtic work, and conſiſts of ſtones which advance beyond the naked, or level, of the building, by reaſon of indentures or channels left in the joinings. Theſe are chiefly uſed in the corners of edifices, and thence called *ruſtic quoins.* The cavities or indentures are ſometimes round, ſometimes chain-framed, or bevelled, ſometimes in a diamond form, and ſometimes incloſed with a cavetto, and ſometimes with a liſtel.

BOSSINEY, a borough-town of Cornwal, ſituated on the Iriſh channel, about fifteen miles north-weſt of Launceſton: W. long. 5°, and N. lat. 50° 40′.

It ſends two members to parliament.

BOSSORA, or Bassora, a large port-town of Aſiatic Turky, in the province of Eyrac Arabic; ſituated on the weſtern ſhore of the river Euphrates, about forty miles north-weſt of the gulph of Perſia, or Boſſora, in E. long. 47°, and N. lat. 30°.

BOSSUPT, a town of Brabant, in the Auſtrian Netherlands, about eight miles ſouth of Louvain: E. lon. 4° 30′, and N. lat. 50° 52′.

BOSTANGIS, in the Turkiſh affairs, perſons employed in the garden of the ſeraglio, out of whoſe number are collected thoſe who are to row in the Grand Signior's brigantines, when he has a mind to divert himſelf with fiſhing, or take the air upon the canal. They who row on the left hand are only capable of mean employments in the gardens; but they who row on the right hand may be promoted to the charge of boſtangi-bachi, who has the general intendency of all the Grand Signior's gardens, and commands above ten thouſand boſtangis.

BOSTON, a port-town of Lincolnſhire, ſituated near the mouth of the river Witham, about twenty-ſix miles ſouth-eaſt of Lincoln: E. long. 15′, and N. lat. 53°.

Boston, is alſo the name of the capital of New-England, ſituated on a peninſula, at the bottom of a fine bay, covered with ſmall iſlands and rocks, and defended by a caſtle and platform of guns: W. long. 71°, and N. lat. 42° 24′.

It is a flouriſhing town, wherein are ten churches, ſix

six of them belonging to independents. The number of its inhabitants are computed to be about fourteen thousand.

BOSWORTH, a market town of Leicestershire, situated about eleven miles south-west of Leicester: W. long. $1^{\circ} 25'$, and N. lat. $52^{\circ} 45'$.

BOTALE *foramen*, in anatomy, a name given to the foramen ovale, from Botall, physician to Charles IX. to whom the discovery of it is ascribed. See FORAMEN *ovale*.

BOTANIST, a person skilled in botany. See BOTANY.

BOTANOPHILI, persons who have treated of plants, not as botanists, but as gardeners, physicians, *&c.*

BOTANY.

BOTANY is that branch of natural history which treats of the uses, characters, classes, orders, genera, and species of plants.

Before we explain the most approved method of distinguishing plants, it will not be improper to inquire into the nature of the science, and what useful or ornamental purposes may be expected from the cultivation of it.

SECT. I. USES OF BOTANY.

WHEN this science is carried no further than to distinguish one plant from another, its uses are few and uninteresting. However, even this exercise is attended with some advantages. It is the first, and a necessary step towards discovering those of a more noble kind. It is the rudiments of the science; and must therefore be acquired before we can expect to arrive at any improvement that may be useful to mankind. This part of botany is likewise more complete and systematic than many other branches of natural history. By means of the classical and generic marks, we are enabled in a few minutes to discover the name of any plant, from whatever quarter of the globe it may be brought. This is exceedingly curious, and altogether incredible to people unacquainted with the nature of the science. When we have learnt the name, we are then in a capacity of consulting authors with regard to the peculiar properties of the plant, so far as they are known.

Besides, there is an elegance and symmetry in plants, which give rise to many agreeable emotions. Their parts, like those of animals, are possessed of all the beauties of utility, regularity, uniformity, order, and proportion. Neither is there any class of natural bodies in which the beauty of variety makes such a capital figure. This variety is chiefly exhibited in the magnitude, figure, colour, odour, and taste of vegetables. It is therefore natural to expect, that the study of botany should have some influence in improving our taste.

But as botany is confessedly a branch of natural history, the botanist ought not to confine his researches to the mere names and characters of plants. He ought to inquire into their qualities. These qualities, indeed, when we talk of vegetables in general, are exceedingly numerous, and the investigation of many of them attended with such difficulty, that no person, however industrious, can ever expect to unfold the whole. But this circumstance does not afford any argument for losing sight of utility altogether. On the contrary, it is the only thing that can give dignity to the science, or entitle it to be ranked as a branch of natural history. There is but little pleasure in studying a science which is already carried to its highest pitch of improvement. The prospect of discovering any thing that may be useful to mankind stimulates our industry, and makes us prosecute our researches with vigour and alacrity.

A botanist, or an inquirer into the nature and properties of vegetables, ought to direct his views principally towards the investigation of useful qualities. For this purpose, in examining plants, he should consider whether they be possessed of any qualities which may render them of use in food, in medicine, or in any of the arts. These are objects worthy the attention of philosophers. Let us examine the assistance that may be expected from the study of botany with regard to these important articles.

1. FOOD.—Many animals are endowed with an instinctive faculty of readily distinguishing whether the food that is presented to them be noxious or salutary. Mankind have no such instinct. They must have recourse to experience and observation. But these are not sufficient to guide us in every case. The traveller is often allured by the agreeableness of smell and taste to eat poisonous fruits. Neither will a general caution not to eat any thing but what we know from experience to be salutary, answer in every emergency. A ship's company, in want of provisions, may be thrown upon an uninhabited coast, or a desert island. Totally ignorant of the nature of the plants which they meet with;—diseases, or scarcity of animals, may render it absolutely necessary to make use of vegetable food;—the consequence is dreadful: They must

muſt firſt eat, before any certain concluſion can be formed. This is not the deſcription of danger ariſing from an imaginary ſituation. Before the vegetables that grow in America, the Eaſt and Weſt Indies, *&c.* became familiar to our ſailors, many lives were loſt by trials of this kind: Neither has all the information received from experience been ſufficient to prevent individuals from ſtill falling a prey to ignorance or raſhneſs.

If the whole ſcience of botany were as complete as ſome of its branches, very little ſkill in it would be ſufficient to guard us infallibly from committing ſuch fatal miſtakes. There are certain orders and claſſes which are called *natural*, becauſe every genus and ſpecies comprehended under them are not only diſtinguiſhed by the ſame characteriſtic marks, but likewiſe poſſeſs the ſame qualities, though not all in an equal degree. For example: Shew a botaniſt the flower of a plant whoſe calix is a double-valved glume, with three ſtamina, two piſtils, and one naked ſeed, he can pronounce with abſolute certainty, that the plant from which the flower was taken bears ſeeds of a farinaceous quality, and that they may be ſafely uſed as food. In like manner, ſhew him a flower with twelve or more ſtamina, all inſerted into the internal ſide of the calix; though it belonged to a plant growing in Japan, he can pronounce, without heſitation, that the fruit of it may be eat with ſafety. On the other hand, ſhow him a plant whoſe flower has five ſtamina, one piſtil, one petal or flower-leaf, and whoſe fruit is of the berry-kind, he will tell you to abſtain from eating it, becauſe it is poiſonous. Many other examples might be given: but we ſhall reſerve them till we come to the medical qualities.

Facts of this kind make botany not only a reſpectable, but a moſt intereſting ſcience. The French and ſome other nations uſe a greater variety of vegetable food than the Britiſh. This practice is attended with many advantages. The greater number of vegetables that are made uſe of in any country, the poor have the greater number of reſources when there happens to be a ſcarcity of any particular kind. It likewiſe affords an opportunity of a more univerſal cultivation. When agriculture or gardening is confined to few plants, there is great hazard from bad ſeaſons and other unavoidable accidents, beſides the certain loſs ariſing from allowing ſuch ſoils as are improper for raiſing the uſual plants to lie unemployed. Though we are principally influenced by example in introducing the culture of new plants; yet the advice and direction of the botaniſt may be uſeful. From his knowledge of the qualities of plants that grow in other countries, he is enabled to gueſs, with tolerable exactneſs, whether they will agree with the ſoil or climate in which they are propoſed to be cultivated. He can do more: he can point out what particular ſpecies of the plant will be moſt eaſily naturalized. Beſides, without having recourſe to the example of foreign countries, the botaniſt can point out a number of plants that grow wild in his own country, which might be cultivated with advantage, as food either for men or cattle. For example, in the whole claſs called *diadelphia* by Linnæus, which includes the polygala, or milk-wort; the anthyllis, or kidney-vetch; the orobus, or heath-peaſe; the lathyrus and vicia, which comprehend a number of plants of the vetch-kind; the ornithopus, or bird's-foot; the hedyſarum, or St-foin; the aſtragalus, or wild liquorice; the medicago, or lucern; the lotus, or bird's-foot trifoil, *&c.*; the leaves are excellent food for cattle, and the ſeeds may be uſed either by men or cattle. In like manner, all the ſeeds of the graſs-kind, which belong to the triandria claſs of Linnæus, and are very numerous, make excellent food for men, and the leaves afford the beſt paſture for cattle. Many of the plants belonging to this claſs are not cultivated in this country, though we have a great variety of them growing wild.

It has been frequently obſerved, that poor people, during a ſcarcity of corn, have been induced to fill their bellies with ſubſtances that were both pernicious and loathſome, while they were trampling under their feet plants that would at once have afforded good nouriſhment and been highly grateful. This conduct could proceed from nothing but their ignorance of the nature and effects of theſe plants, and from their not being able to diſtinguiſh the noxious ones from the ſalutary. It is the duty of every man to point out the remedy for calamities of this kind, eſpecially when it is not impoſſible that the cauſes which produced them may exiſt in ſome future period. For this purpoſe, we ſhall ſubjoin a ſhort liſt of native plants that may be eat with ſafety and advantage.

Salicornia Europæa, or marſh-ſamphire, jointed glaſswort, or ſaltwort. This plant grows plentifully near the ſea-coaſts, and eats very well with ſalt and vinegar.

Veronica becabunga, or common brook-lime. This plant, which grows in marſhes, is commonly gathered in the ſpring, and eat as a ſallad.

Valeriana locuſta, lamb's-lettuce, or corn-ſallet, grows in corn-fields and paſture-grounds. The leaves are reckoned more wholeſome than the common lettuce cultivated in our gardens.

Scirpus maritimus, or round-rooted cyperus, grows near the ſea-ſhores. The root conſiſts of a number of knots, which, after being dried and grinded, have been frequently uſed as bread when proviſions were ſcarce.

Bromus ſecalinus, or field brome-graſs, grows in vaſt quantities in rye-fields, eſpecially after the rye is cut down. The ſeeds of this plant, mixed with grain of a better quality, make very good bread: But if the quantity of brome-graſs ſeeds be great, the people who uſe the bread are apt at firſt to be affected with a ſlight degree of intoxication; but this effect ceaſes, after being a little accuſtomed to the food.

Feſtuca fluitans, or flote-feſcue-graſs, grows in ditches and marſhy places. In Sweden and Germany, the ſeeds are uſed in broths and gruels, on account both of their nutritive quality and agreeable flavour. When grinded, and made into bread, they are eſteemed little inferior to wheat or oats.

Triticum repens, common wheat-graſs, dog's-graſs, quick-graſs, or couch-graſs, grows ſo plentifully in our fields, that it is a great object with farmers to root it out. The roots of this plant, after being waſhed, dried, and grinded, have often been uſed as bread in a dearth of corn.

With

With regard to the other kinds of grafs, the feeds of them may be fafely ufed as food; but fome of them are fo fmall, that a fufficient quantity cannot eafily be collected.

Campanula, or bell-flower. Nine or ten fpecies of bell-flower grow in Britain. Both the roots and leaves, when boiled, efpecially before the ftalk grows up, may be ufed.

Chenopodium bonus henricus, common Englifh mercury, or all-good, grows almoft every where. This plant is ufed in broth by the country-people, in place of cabbage or other pot-herbs. When the young leaves and ftalks are dreffed with butter, they are not inferior, in their flavour and nutritive power, to afparagus or fpinage.

Eryngium maritimum, fea-holly, or eryngo, generally grows near the fea-fhore. The young twigs, prepared as afparagus, are grateful to the tafte, very nourifhing, and give vigour to the body.

Daucus carota, wild carrot, or bird's-neft, grows in every field. It is the fame fpecies with the carrot cultivated in gardens, and is equally nourifhing.

Heracleum fphondylium, or cow-parfnip. The inhabitants of Poland and Lithuania make a fermented liquor of the feeds and leaves, which the poorer fort ufe as ale. The inhabitants of Camfcatka eat the ftalks, after peeling off the bark.

Carum carvi, or caraways, grows in meadows and pafture-grounds. The young roots of this plant are more agreeable to the tafte than the parfnip, and therefore might be of great fervice to the poor in a dearth of provifions.

Convallaria polygonatum, or fweet-fmelling Solomon's-feal, grows in the cliffs of rocks. The roots are made into bread, and eat by the inhabitants of Lapland, when corn is fcarce. The Turks ufe the young ftalks as afparagus.

Bunium bulbocaftanum, earth-nut, kipper-nut, pig-nut, or hawk-nut, grows plentifully on lea-grounds, the banks of rivers, fides of hills, *&c.* The roots are very fweet, afford excellent nourifhment, and may be eat either raw, boiled, or roafted.

Vaccinium uliginofum, the great bilberry-bufh, grows upon high grounds. The berries are much eat by children; but when taken in too great quantity, are apt to occafion a giddinefs and headach.

Vaccinium myrtyllis, black whorts, whortle-berries, or bilberries, grows in woods. The berries have a fine flavour, and may be eat with fafety.

Vaccinium vitis idea, red whorts, or whortle-berries, grows on hills. The berries are eat in the autumn, and many people make an excellent jelly of them.

Polygonum viviparum, fmall biftort, or fnake-weed, grows upon high grounds. The roots may be prepared into bread. In Lapland and the northern parts of Europe, it is principally eat along with the flefh of ftags and other wild animals.

Spergula arvenfis, or corn-fpurrey, grows in corn-fields, efpecially in fandy foils. In Norway, they collect the feeds of this plant, and make them into bread.

Sedum rupeftre, or St Vincent's rock ftone-crop, grows on high grounds. The Swifs cultivate this plant, and ufe it as a pot-herb.

Prunus padus, wild clufter-cherry, or bird's-cherry, grows in woods and hedges. Some people eat the berries with falt.

Prunus fpinofa, the black-thorn, or floe-tree, grows in hedges and woods. The berries are very auftere; but the leaves are tender, and, when gently toafted, may be ufed in place of tea.

Prunus cerafus, or black-cherry, grows likewife in woods and hedges. The berries are eat both in a crude and dried ftate. When this plant is wounded, a gum exfudes from it nearly of the fame quality with gum-arabic. Dr Haffelquift informs us, that above 100 men, when befieged in an Egyptian town, were preferved alive for more than two months, without any other fuftenance than they derived from the ufe of this gum.

Cratægus aria, or the white bean-tree, grows in woods. The berries are eat by the peafants; and in Sweden they are prepared and ufed as bread when there is a fcarcity of corn.

Cratægus oxycantha, the white thorn, or hawthorn, grows every where in woods and hedges. The berries, when dried and grinded, are fometimes made into bread; but it is apt to bind the belly too much.

Sorbus aucuparia, the quicken-tree, or mountain-afh, grows in woods. Very good cyder is made of the berries; and, when dried, they make very wholefome bread.

Rofa canina, red-flowered dog's-rofe, or hip-tree, grows in hedges. The berries afford excellent nourifhment, and may either be eat in a crude ftate, or dried and made into bread.

Spiræa filipendula, or drop-wort, grows in pafture-grounds and the fides of hills. The roots of this plant, which are compofed of fmall tubercles like peafe, when dried and grinded, make tolerably good bread.

Ranunculus ficaria, pile-wort, or leffer celadine, grows in pafture-grounds, *&c.* The Norwegians collect the leaves in the fpring, and ufe them in broth.

Origanum vulgare, or wild marjoram, grows in hedges and among brufh-wood. The leaves of this plant, when toafted, and infufed in boiling water, have fuch a refemblance to tea, that it is difficult to make a diftinction. As tea is fo univerfally ufed in diet, it is much to be regretted that the ladies cannot be prevailed upon to prefer this or fome other of our own plants, and thereby fave fome millions fterling annually to their country.

Stachys paluftris, or clown's all-heal, grows in marfhes and the banks of rivers. The roots are fucculent, and may be ufed either boiled, or dried and made into bread.

Melampyrum arvenfe, or purple cow-wheat, grows in corn-fields. Bread is fometimes made of the feeds; but it is a little bitter.

Sinapis arvenfis, wild muftard, or charlock, grows plentifully in corn-fields, *&c.* The leaves of this plant are often ufed in broth.

Crambe maritima, or fea-colewort, grows in fandy ground near the fea-fhore. The leaves, when young and tender, may be ufed in place of cabbage; but when too old, are apt to make the head giddy.

Malva rotundifolia, or dwarf-mallow, and malva fylveftris, or common mallow, are every where to be met with. The leaves of both thefe plants may be ufed in broth.

Orobus tuberoſus, wood-peaſe, or heath-peaſe, grows in paſture-ground, woods, hedges, *&c.* The roots, when boiled, or made into bread, afford excellent nouriſhment.

Piſum maritimum, or ſea-peaſe. In the year 1655, when a great famine prevailed in England, the poor people in Oxfordſhire lived principally upon the ſeeds of this plant.

Trifolium repens, or white clover, grows in meadows and paſture-grounds. The flowers of this plant, when dried, make tolerably good bread.

Trifolium pratenſe, purple or honeyſuckle clover. The Scotch, when oppreſſed with a famine, uſed bread made of the flowers of this plant. And indeed bread may be made of the flowers of every plant belonging to the claſs called *diadelphia*, which comprehends near 600 ſpecies.

Hipochræſis maculata, or ſpotted hawkweed, grows on high paſture-grounds. The peaſants of Norway uſe the leaves as cabbage.

Sonchus oleraceus, or common ſow-thiſtle. The young leaves eat exceedingly well when boiled.

Tragopodon pratenſe, or yellow goat's-beard, grows in meadows and paſture-grounds. The roots, when dug up before the plant flowers, have a fine flavour, and are very nouriſhing.

Aretium lappa, or burdock. The young ſtalks, when the bark is taken off, eat, when boiled, like aſparagus. Some people uſe them in a crude ſtate, with oil and vinegar.

Carduus paluſtris, or marſh-thiſtle. Almoſt all the ſpecies of thiſtle may be uſed in the ſame manner as the burdock.

Urtica dioica, or common nettle. The uſe of this plant as a pot-herb is well known.

Quercus robur, or common oak. Acorns, during a famine, have often been made into bread.

Fagus ſylvatica, or beach tree. Bread has ſometimes been made of the nuts; but unleſs they be well dried, the bread made of them will produce a ſlight degree of intoxication.

Corylus avellana, or the haſel-nut tree. Every body knows the agreeable flavour and nutritive quality of haſel nuts.

Pinus ſylveſtris, or Scots fir. The Norwegians and others make bread of this tree in the following manner: They ſelect ſuch trunks as are moſt ſmooth and have leaſt reſin; they take off the bark, then dry it in the ſhade, and afterwards toaſt it over a fire, and grind it into meal. They generally mix with it a little oat-meal or barley. This bread, made of fir-bark, is not only uſed in a ſcarcity of proviſions, but is eat at all times by the poorer ſort.

Lichen iſlandicus, or eryngo-leaved liver-wort, grows among heath and upon high grounds. The inhabitants of Iceland have long uſed this plant, both boiled, and in the form of bread.

Lichen velleus, or fleecy liver-wort, grows upon hills. In time of famine, the inhabitants uſed this plant for food.

Fungus, or muſhroom. The ſpecies of this plant are very numerous. Some of them are uſed by the rich; rather as a ſeaſoning, than as food. When taken in too great quantity, they are abſolutely indigeſtible; and, unleſs thrown up from the ſtomach, will prove as fatal as the moſt deadly poiſon. The poor, therefore, who would be very apt to fall into this error, had better refrain from the uſe of muſhrooms altogether.

From this ſhort liſt of eſculent plants that grow wild in our own country, we ſee how liberally we are provided with reſources in caſe of a ſcarcity of the vegetables uſually cultivated for food, and at the ſame time the advantages that might be derived from a very ſlight degree of knowledge in botany. Many of theſe plants grow beſt in ſoils which cannot be employed for raiſing corn of any kind. Beſides, they are exceedingly hardy, and ſuffer but little from ſeaſons, which in a great meaſure deſtroy the more delicate plants which we cultivate with ſo much labour and expence. It may be further remarked, that many improvements in agriculture and the uſeful part of gardening might be expected from propagating a taſte for reſearches into the nature and properties of vegetables.

2. Medicine.—It is an unhappy circumſtance, that the bulk of phyſicians in all ages have been more remarkable for their attachment to the abſtruſe and uſeleſs parts of the ſcience, than to the nature and cure of diſeaſes, the proper objects of their profeſſion. Inſtead of diſputing in folio how ſuch a plant cures ſuch a diſeaſe, had they exerted their induſtry and genius in aſcertaining the fact, and then proceeded to make further inquiries into the qualities of other ſimples, the practice of phyſic would not have been a thing of ſuch a fluctuating nature as it ever has been, and ſtill continues to be.

Many practitioners, ſome of them men of conſiderable abilities, affect to deſpiſe the ſcience of botany, alledging that it affords no aſſiſtance to their art; and that it is very uſeleſs to load their memories with a long catalogue of hard names, without being a whit the wiſer with regard to the medical properties. Beſides, they imagine every ſingle genus and ſpecies of the whole vegetable tribes to be poſſeſſed of peculiar and diſtinct properties; and that it would require the labour of a whole life time to aſcertain the virtues of a few plants.

It muſt indeed be confeſſed, that the writers and teachers of botany have not been ſufficiently careful to prevent reflections of this kind. The technical part of the ſcience ingroſſes their chief attention: If the virtues are talked of, it is only in a curſory manner: The only thing that can render the ſcience reſpectable, is either totally omitted in their ſyſtems, or diſpatched in a line or two. But we are happy to find, that the ſcience begins now to get ſome footing in this country. By the induſtry and ſpirit of a worthy Profeſſor *, the taſte has been propagated

* Dr John Hope profeſſor of medicine and botany in the univerſity of Edinburgh. Immediately after the Doctor's admiſſion to the botanical chair, he offered gold and ſilver medals to his ſtudents for the beſt collections of indigenous plants

gated in a few years far beyond what could have been expected, eſpecially when the ſtate of the country before that period is taken into conſideration.

We have no doubt of being able to ſhew, that botany, even in its preſent ſtate, is ſo far from lying open to the objections brought againſt it by thoſe who are either unacquainted with it, or affect to deſpiſe it as uſeleſs and trifling, that we have little reaſon to hope for any extenſive inſight into the medical virtues of plants by any other means.

In order to bring the numerous tribes of vegetables under certain claſſes or denominations, various methods have been adopted by different authors. Some have claſſed them by the figure of their roots; ſome by the caulis or ſtems; ſome by the leaves. Linnæus has preferred the parts of fructification, becauſe theſe are not only the moſt eſſential, but likewiſe the moſt univerſal.

This method of claſſing is preferable to any that has been propoſed, on many accounts. It is found by experience, that plants which are diſtinguiſhed by the ſame characters in the flower and fruit, have preciſely the ſame qualities, though not always in an equal degree as to ſtrength or weakneſs; ſo that, upon inſpection of the flower and fruit, a botaniſt can determine *à priori* the effects that will reſult from the plant when taken into the ſtomach. Here then is a foundation for natural claſſes. In order, therefore, to determine the medical virtues of all the plants belonging to a natural claſs, the phyſician has nothing further to do than to aſcertain, by a ſet of clear and unqueſtionable experiments, the virtues of any one of them. This greatly ſhortens the labour of inveſtigation. Suppoſing the number of known ſpecies to be 20,000, by aſcertaining the virtues of one genus, at a medium, you determine the virtues of 12 ſpecies. But, by aſcertaining the virtues of one genus belonging to a natural order, the virtues of perhaps 300 or 400 ſpecies are aſcertained. Again, by aſcertaining the virtues of one genus belonging to a natural claſs, you diſcover the virtues of perhaps 800 or 1000 ſpecies.

As this branch of the materia medica has been hitherto greatly neglected, we ſhall ſubjoin a few examples of natural orders and claſſes, with the virtues they are ſuppoſed to poſſeſs.

The Stellatæ of Mr Ray, which make the 44th natural order of Linnæus, are ſaid to be all diuretics. Of theſe, the rubia and aſperula are remarkable for their diuretic and detergent qualities, and as ſuch are admitted into both the Edinburgh and London diſpenſatories. The aparine, gallium, *&c.* poſſeſs the ſame qualities, though not perhaps in an equal degree.

The Asperifoliæ of Ray, belong to the pentandria monogynia claſs, with one petal and four ſeeds, of Linnæus, and form his 43d natural order. The plants of this order are ſaid to be aſtringent and vulnerary. Under it the following genera are comprehended: Tournefortia, cerinthe, ſymphytum, pulmonaria, borrago, cynogloſſum, anchuſa, lithoſpermum, myoſotis, heliotropium, aſperugo, lycopſis, echium.

The plants included under the Pentandria, with one ſtylus, one flower-leaf, and which bear berries, form the 33d natural order, and are generally poiſonous. To this order belong all the ſolana, or night-ſhades; the mandragora and atropa, which are well known to be poiſonous; the hyoſcyamus and datura occaſion madneſs and death; the verbaſcum intoxicates and kills fiſhes.

The Umbellatæ, which make the 22d natural order, are ſaid to be aromatic, reſolvent, and carminative, eſpecially thoſe that grow in a dry ſoil; but ſuch of them as grow in a wet ſoil are ſaid to be poiſonous. The virtues reſide in the roots and ſeeds. To this order belong the daucus creticus, gentiana alba, ſiler montanum, ammi verum, petroſelinum macedonicum, *&c.*

The roots of the plants belonging to the Hexandria claſs, are either eſculent or poiſonous. Theſe qualities may be diſtinguiſhed by the taſte and ſmell. In the 7th, 8th, 9th, and 10th natural orders, the following poiſonous plants of the hexandria claſs are enumerated, *viz.* the leucoium, galanthus, pancratium, amaryllis, fritillaria, corona imperialis, glorioſa, convallaria, hyacinthus, aloes, *&c.* The allium, cepa, and porum, are acrid; and, when taken in too great a quantity, are highly corroſive; but, as this hurtful quality is owing to a volatile alkaline ſubſtance in the roots, when they are roaſted or boiled it flies off, and they may be eat with ſafety.

The fruit of all the plants belonging to the Icosandria claſs, which are enumerated in the 36th, 37th, 38th, and 39th natural orders, are eſculent, and not one of them poiſonous. To this claſs belong the eugenia, punica, ceraſus, crategus, pyrus, roſa, fragaria, *&c.*

The plants belonging to the Polyandria claſs, or the 23d natural order, are moſtly poiſonous, *e. g.* the nymphæa, argemone, papaver, actæa, bocconia, euphorbia, delphinium, ſtaphiſagria, aconitum, nigella, errhina, aquilegia, helleborus, *&c.*

The leaves of the plants belonging to the Didynamia Gymnospermia, or 58th natural order, are ſaid to be cephalic and reſolvent. This order contains the ajuga, teucrium, hyſopus, lavendula, mentha, lamium, betonica, ballota, leonurus, origanum, thymus, meliſſa, dracocephalum, *&c.*

The plants belonging to the Tetradynamia claſs, or the 57th natural order, are antiſcorbutic, and a little acrid; *e. g.* the lepidium, cochlearia, raphanus, cardamine, ſinapis, eryſimum barbarea, ſiſymbrium, *&c.*

All the plants of the Monodelphia claſs, which form the 34th natural order, are emollient and mucilaginous. Whoever knows the qualities of the althea and malva, knows the qualities of the whole claſs, which comprehends about 180 ſpecies. The emollient and mucilaginous virtues are not confined to the leaves or any par-

plants prepared in the manner of a hortus ſiccus. The conſequence of this plan fully anſwered his expectations. In a few years, he was in poſſeſſion of many more plants than were ever formerly ſuppoſed to grow in Scotland. After this acquiſition, the Dr judiciouſly changed the object of his medals, and offered them for the beſt accounts of the ſenſible qualities and medical virtues of any number of native plants. But we are ſorry to find, that no gentlemen have hitherto become candidates for theſe medals ſince they were offered upon this ſenſible and uſeful plan.

particular part, but are diffufed through the whole plant.

The Diadelphia clafs forms the 55th natural order. This clafs comprehends above 500 fpecies; and, as was obferved above, the feeds of every one of them are efculent, the leaves afford excellent pafture for cattle, and not one of them have any poifonous quality.

The Syngenesia clafs, or 21ft natural order, contains a very great number of fpecies. The virtues of fome plants belonging to this clafs are faid to differ confiderably. The bardana, carlina, tuffilago, arnica, cichorium, fcorzonera, taraxacum, *&c.* are fuppofed to be deobftruent, and are kept as fuch in the fhops. But the greateft number of them are bitter and ftomachic; *e. g.* the abfinthium abrotanum, artemifia, fantolina, balfamita, tanacetum eupatorium, matricaria, chamomilla, acmella, verbefina, *&c.*

The Gynandria Diandria, or 4th natural order, are faid to excite venery; *e. g.* the orchis, fatyrium, ferapias, herminium, ophrys, epidendrum, *&c.* The roots of thefe are ufed with this intention by practitioners.

The Amentaceæ Acifoliæ, or 15th natural order, are refinous; *e. g.* the pinus, abies, juniperus, cupreffus, *&c.* They are all warm ftimulants and diuretics.

The virtues of the Cryptogamia clafs, which comprehends the 61ft, 62d, 63d, and 64th natural orders, are moftly of a fufpicious nature. Hardly any of the filices are efculent; their fmell is difagreeable, and they are faid to kill worms. All the mufci, except the lichen iflandicus, are improper for food. Some of the fungi are eat; but they are a very dangerous food.

Plants which have their nectaria feparate from the flowers, are commonly poifonous; *e. g.* the epimedium, nigella, aquilegia, aconitum, monotropa, helleborus, *&c.*

Thofe plants which are called *lactefcent*, from their oozing out a whitifh juice upon being wounded, are generally poifonous; *e. g.* the euphorbia, papaver, periploca, cynanthum, *&c.* But thofe which are called *femiflofculofæ* by Tournefort, are of a milder nature; *e. g.* lactuca, hieracium, crepis, leontodon, *&c.*

Befides natural claffes and orders, which prefuppofe fome acquaintance with botany, we are provided with other means of difcovering the general qualities of plants. The fenfations of fmell and tafte give us fome intimation of the nature and qualities of plants. An agreeable tafte or fmell is feldom accompanied with noxious qualities; on the other hand, when thefe fenfes are difagreeably affected, the qualities are generally more or lefs noxious, being either purgative, emetic, or poifonous. Plants that have a fweet tafte are generally nutritive; thofe that have a falt tafte are warm and ftimulant. Plants of an acrid tafte are corrofive; but, when deprived of their acrimony by drying, fome of them become fit for food. Bitter plants are alkaline, ftomachic, and fometimes of a fufpicious nature. Acid plants are cooling, and allay thirft; but thofe of an auftere tafte are aftringent.

Even the colour and afpect of plants throw fome light upon their nature. Flowers or fruit of a red colour are generally acid. Yellow flowers indicate a bitter tafte. Plants that have green flowers are crude; thofe of a pale colour are commonly infipid; thofe of a white colour are generally fweet; and thofe whofe flowers have a gloomy and difmal afpect, are moftly poifonous.

Thefe examples naturally fuggeft the following obfervations.—The Creator of the univerfe hath endowed us with fufficient abilities for inveftigating the virtues of plants, and applying them to the cure of difeafes and other ufeful purpofes, even on the fuppofition that we were obliged to afcertain the virtues of every fingle plant by experiments. But this labour, though practicable in a courfe of years, and under proper regulations, is greatly abridged. The information afforded by the fenfes is confiderable. Our inquiries are ftill further affifted by the general diftribution of vegetables into tribes and families. The mutual relation and connection of thefe tribes depend not upon fancy or conjecture: The relations are fo ftrongly marked by the fimilarity of their flowers, fruit, and fenfible qualities, that they are confpicuous at firft fight.

A perfon unacquainted with medicine, from this view of the virtues of plants, will be apt to imagine, that botany is the only road to that fcience; and of courfe that every phyfician muft either be a good botanift, or a bad practitioner. The thought is natural, and, with fome limitation, not unjuft. The common practice of phyfic does not require an extenfive fkill in the virtues of plants. A certain number of vegetables and other fubftances are kept in the fhops, and recommended for particular purpofes in difpenfatories and books of practice. It is the bufinefs of the practitioner to have a general acquaintance with thefe, and to prefcribe them according to the cuftom of the times. But inveftigations into the nature and properties of fimples or drugs, require more time than can be beftowed by men of bufinefs. Whenever any fcience is converted into a trade, and the ftudy of it confined to people who muft live by it, there is little profpect of improvement. This has been the fate of phyfic. Every body difpenfes medicines; but few are none inquire into their virtues. Some valuable medicines have been difcovered. But by whom? Not by phyficians; but by favages, old women, priefts, and chymifts. Until, therefore, the ftudy of phyfic be confidered as a branch of natural hiftory, and cultivated by people who have time to make experiments, the fcience muft continue to be vague, defultory, and limited in its utility.

Botany has always been confidered as a branch of natural hiftory. But, as was formerly obferved, the ufeful part of it hath been too much neglected. The virtues of plants may be fuccefsfully inveftigated without an extenfive knowledge in all the branches of the medical art. To propagate a tafte for inquiries into the nature and properties of vegetables, would therefore lay the moft folid foundation for improvements in medicine.

3. Arts.—The application of the qualities of vegetables to the various mechanical arts affords a moft extenfive field for ufeful obfervation. There are few plants, however different in their nature, but are found by experience to be not only the moft proper, but effentially neceffary, in fome particular art or employment.

The qualities which render vegetables fo generally applicable to mechanical employments are principally thefe:

Softnefs

Plate LIII

J. Bell Sculp.

Softnefs or hardnefs of texture, elafticity, inflammability, aftringency, colour, *&c.* Hence fome plants are proper for domeftic utenfils, others for dying, tanning, *&c.* Some may be apt to think that qualities of this kind are not the proper objects of botany. But if the natural hiftorian be at liberty to neglect ufeful qualities, he deferves little thanks for expatiating on thofe that are ufelefs. It would be foreign to our defign in this place, to enumerate the particular plants that are ufed for the various purpofes of the mechanic. We fhall however, by way of fpecimen, fubjoin a lift of plants that change the colour of cloths and other fubftances.

List *of* Dying Plants.

YELLOW.

Curcuma, or turmeric. This plant grows in the Eaft Indies; the root of it tinges a rich yellow colour; but it is not very durable.

Rumex maritimus, or golden dock, grows on roadfides, *&c.* The root dyes a fine yellow.

Thalictrum flavum, or meadow-rue, grows in marfhes, on the banks of rivers, *&c.* Both the root and the leaves dye a very deep yellow.

Urtica dioica, or common nettle. The country people dye eggs a beautiful yellow with the roots of this plant at the feaft of Eafter.

Santalum album, or white fanders. The wood of this tree, which is a native of the Eaft Indies, dyes a good yellow.

Lawfonia inermis, or alkanna, is a fmall fhrub cultivated in Afia and Africa. The ftem and branches of this plant afford an excellent yellow; the natives paint their bodies with it. The root, prepared with quick-lime, gives a fine fhining red. The natives ufe it for dying their teeth, nails, faces, the mains of their horfes, leather, *&c.*

Morus tinctoria, or fuftic, grows in America. The wood of this tree is in great efteem among dyers for the fine yellow it affords.

Rhamnus frangula, or the black berry-bearing alder, grows in woods and hedges. The bark tinges a dull yellow; and the unripe berries dye woollen ftuffs green.

Rhamnus catharticus, or purging buck-thorn, grows wild in woods and hedges. The bark gives a beautiful yellow.

Rhamnus minor, grows in the fouthern parts of Europe. The berries give an excellent yellow.

Rhus Coriaria, or fumach, grows in Italy, *&c.* The bark of the ftem gives a yellow colour, and the bark of the root a yellowifh red.

Berberis vulgaris, barberry or pipperidge-bufh. The root of this plant gives an excellent yellow to cloth; and the bark gives leather a beautiful yellow colour.

Prunus domeftica, or common plumb-tree. The country people ufe the bark for dying their cloth yellow.

Pyrus malus, or apple-tree. The dyers ufe the bark for giving cloth a yellow colour.

Carpinus betulus, the horn or hard beam tree, horfe or horn-beach tree, grows in woods. The bark is ufed as a yellow dye.

Refeda luteola, or bafe-rocket, grows in pafture grounds, meadows, and efpecially on a chalky foil. This herb, which is a native of Scotland, gives cloth a moft beautiful yellow colour, and is much ufed by dyers, who import it in large quantities, though it might be eafily cultivated in our own country.

Serratula tinctoria, or faw-wort, grows in woods and meadows. This plant gives the fame colour with the refeda, and, though not fo beautiful, is much ufed by dyers.

Hierachium umbellatum, or narrow-leaved bufhy hawkweed, grows in woods, hedges, and gravelly foils. This plant gives a very fine yellow.

Acanthus mollis, is a native of Italy. It appears that this plant was ufed by the ancients for dying yellow:

Et circumtextum croceo velamen acantho. Virg.

Bidens tripartita, or trifid water hemp-agrimony, grows in marfhy places. This plant gives a pretty elegant yellow.

Xanthium ftrumarium, or leffer burdock, grows near dunghills. When this plant is boiled entire, together with the fruit, it gives a pretty good yellow.

Salix pentandra, or fweet willow. The dried leaves give a fine yellow.

Betula alba, or birch tree. The leaves give a faint yellow colour to cloth.

Stachys filvatica, or hedge-nettle, grows in woods and hedges, and gives a yellow colour to cloth.

Centaurea jacea, or common knapweed, grows in pafture and barren grounds. This plant is often ufed as a fuccedaneum for the ferratula or faw-wort.

Polygonum perficaria, dead or fpotted arfmart, grows in corn-fields, *&c.* and dyes cloth yellow.

Lyfimacha vulgaris, yellow willow-herb, or loofe-ftrife, grows in marfhes, and on the banks of rivers. This herb faid to dye yellow.

Scabiofa fuccifa, or devil's-bit, grows in meadows and pafture-grounds. The dried leaves give a yellow colour; but it is feldom ufed.

Anthyllus vulneraria, kidney-vetch, or ladies-finger, grows on dry pafture-grounds. The country people ufe this plant for dying their cloth yellow.

Lichen juniperus, or juniper-liverwort, grows on the trunks and branches of trees. Lichen parietinus, or common liver-wort, grows on walls and the bark of trees. Lichen candelarius, or yellow liverwort. Thefe three fpecies of liverwort are ufed by the common people for dying their ftuffs yellow.

Anthemis tinctoria, or common ox-eye, grows on high grounds. The flowers give a bright yellow colour.

Chærophyllum fylveftre, wild cicely, or cow-weed, grows in hedges, *&c.* The umbel or tops and flowers of this plant give an excellent yellow.

Thafpia villofa, or deadly carrot, grows in Spain; and its umbel is ufed as a yellow dye by the inhabitants of that country.

Genifta tinctoria, green wood, dyers-weed or woadwaxen, grows in pafture-grounds, *&c.* The flowers are much ufed as a yellow dye.

Hypericum perforatum, or St. John's wort, grows among brufh-wood and in hedges. The flowers are ufed as a yellow dye, but it is not much efteemed.

Calendula officinalis, or garden marygold. The dried flower-leaves are sometimes used as a yellow dye: Their expressed juice, boiled with alum, makes an excellent yellow paint.

RED.

Rubia tinctorum, or madder, grows in the southern parts of Europe. The roots are much used by dyers for giving a red colour to cloth.

Gallium boreale, or crosswort madder; gallium verum, yellow ladies bed-straw, or cheese-rening. Both these plants grow plentifully in our own country; and their roots are used for dying cloth red.

Lithospermum tinctorium, grows in France. The root gives a red colour, but it is not easily fixed.

Rumex acetosa, or common sorrel, grows in meadows and pasture-grounds. The root is used by apothecaries for tinging decoctions, *&c.* with a red colour; but it is not used by dyers.

Cæsalpina Brasiliensis, or Brasil wood, is a native of the East Indies. The wood is commonly used by the dyers for giving a red colour.

Calamus rotang, or dragon's blood, is an East-India fruit. The inspissated juice is principally used by apothecaries for giving a red tinge to their medicines.

Bixa orellana, grows in both the Indies. The seeds of this tree are much used as a red dye, and the natives of America paint their bodies with them.

PURPLE.

Cæsalpinia vesicaria. The wood of this tree gives a purple dye. The cæsalpinia sappan is used for the same purpose. The lignum rubrum, or Fernambuca wood, gives likewise a reddish purple dye.

Origanum vulgare, or wild marjoram, grows in woods, *&c.* The tops of this plant are used for dying cloth purple.

Carthamus tinctorius, is an annual plant, and a native of Egypt. The corollæ of this plant give a fiery red colour to cloth; but they are principally used for dying silks.

BLUE.

Isatis tinctoria, or woad. This plant grows wild in corn-fields, and gives a blue colour to cloth.

Indigofera tinctoria, or indigo, grows in the East Indies. The blue dye given to cloth by this plant is preferable to any other; because it is of so fixed and durable a nature, that it is not affected either by acid or alkaline substances.

Galega tinctoria, is a perennial plant of Zeylon. Hermannus affirms, that the blue obtained from this plant is even preferable to the indigo, although it has never hitherto been used by Europeans.

Fraxinus excelsior, or common ash-tree. The bark tinges water blue; and the inner bark is said to give cloth a very good blue colour.

VIOLET.

Hæmatoxylon campechianum, or logwood, grows in the West Indies, and gives cloth a violet colour. It is, however, chiefly used as a basis for some other colours.

Empetrum nigrum, black-berried heath, crow or crake-berries, grows on high grounds. The berries, boiled with alum, are used as a purple dye.

GREEN.

Senecio jacobæa, or common raywort, grows in pasture-grounds, *&c.* The whole plant is used, before it begins to flower, for dying cloths greeen.

Chærophyllum sylvestre, or wild cicely. This plant, when the tops are taken off, dyes cloth a beautiful green.

Iris germanica, grows in the southern parts of Europe. The expressed juice of the corolla gives a green dye.

BLACK.

Lycopus europæus, or water horehound, grows in marshy places. The juice of this plant gives a black dye of such a fixed nature, that it cannot be washed out.

Actæa spicata, herb-christopher, or barberries, grows among brushwood. The juice of the berries, when boiled with alum, affords a fine black ink.

Genipa americana, is an American tree. The unripe berries tinge cloths with a deep black. The natives dye their mouth with these berries, to give them a terrible aspect to the enemy. It remains fixed for many days.

Quercus, or oak-tree. The capsulæ of the oak, on account of their great stipticity, are used for fixing and improving the mineral black. They are used both by dyers and curriers.

This short sketch of the utility of botany with regard to Food, Medicine, and the Arts, will be sufficient to suggest the many advantages that may be expected from the cultivation of it. The objects presented by the science are curious, respectable, and useful. The natural history of plants is not even confined to the above important articles. It is strictly connected with agriculture and gardening. The structure of vegetables, the soils that naturally produce particular kinds, things that promote or retard their growth, are essential parts of their natural history. Hence a school of botany, especially when sufficient attention is paid to the useful part of the science, merits the highest encouragement from the public, and ought to be attended by farmers, landed gentlemen, gardeners, *&c.* as well as by physicians and philosophers.

SECT.

S E C T. II. *Of the* Method *of reducing* Plants *to* Classes, Orders, Genera, *and* Species; *and of investigating their* generic *and* specific names *by certain* marks *or* characters.

We observed in the former section, that in the progress of this part of botany many different methods had been followed by different authors. Cæsalpinus, Ray, Bauhinus, Van Royan, Ricinus, Tournefort, Linnæus, Sauvages, have each adopted a peculiar method of characterizing and classing plants. It would be foolish to distract the attention of the reader by an explanation of all these methods. We shall therefore proceed to explain that of Linnæus, which is perhaps the only one now taught in Europe.

This method of reducing plants to classes, genera, and species, is founded upon the supposition that vegetables propagate their species in a manner similar to that of animals. Linnæus endeavours to support this hypothesis by the many analogies that subsist between plants and animals, which shall be more particularly pointed out in the third section. It is from this circumstance that Linnæus's system of botany has got the name of the *sexual system*. The names of his classes, orders, *&c.* are all derived from this theory. He calls the stamina of flowers the *males*, or the male parts of generation; and the pistils *females*, or the female parts of generation. Plants whose flowers contain both male and female parts, are said to be *hermaphrodites*, &c. His classes, orders, and genera, are all derived from the number, situation, proportion, and other circumstances attending these parts, as will appear from the following scheme.

SCHEME *of the* Sexual System. *See* Plate LIII.

Plants celebrate their nuptials,

- Either publicly, *i. e.* have visible flowers.
  - *Monoclinia*, males and females in the same bed:—*i. e.* The flowers are all hermaphrodite, having stamina and pistils in the same flower.
    - *Diffinitas*, the males or stamina unconnected with each other.
      - *Indifferentissimus*, the males or stamina having no determinate proportion betwixt each other as to length.
        1. Monandria, *i. e.* one male or stamen in a hermaphrodite flower.
        2. Diandria, —— two males or stamina.
        3. Triandria, —— three males.
        4. Tetrandria, —— four males.
        5. Pentandria, —— five males.
        6. Hexandria, —— six males.
        7. Heptandria, —— seven males.
        8. Octandria, —— eight males.
        9. Enneandria, —— nine males.
        10. Decandria, —— ten males.
        11. Dodecandria, —— eleven males.
        12. Icosandria, —— twenty, or more males inserted into the calix, and not into the receptacle.
        13. Polyandria, —— all above twenty males inserted into the receptacle.
      - *Subordinatio*, two of the males or stamina uniformly shorter than the rest.
        14. Didynamia, —— four males, two of them uniformly shorter than the other two.
        15. Tetradynamia, —— six males, two of which are uniformly shorter than the rest.
    - *Affinitas*, the males or stamina either connected to each other, or to the pistillum.
      16. Monodelphia, the males or stamina united into one body by the filaments.
      17. Diadelphia, the stamina united into two bodies or bundles by the filaments.
      18. Polyadelphia, the stamina united into three or more bundles by the filaments.
      19. Syngenesia, the stamina united in a cylindrical form by the antheræ.
      20. Gynandria, the stamina inserted into the pistillum.
  - *Diclinia*, males and females in separate beds; *i. e.* plants that have male and female flowers in the same species.
    21. Monoecia, male and female flowers in the same plant.
    22. Dioecia, male flowers in one plant, and females in another, of the same species.
    23. Polygamia, male, female, and hermaphrodite flowers in the same species.
- Or clandestinely, *i. e.* whose parts of fructification are invisible.
  24. Cryptogamia, the flowers invisible, so that they cannot be ranked according to the parts of fructification.

These

These twenty-four classes comprehend every known genus and species. It is an easy matter to class a plant belonging to any of the first eleven classes, as they all depend on the number of stamina or male parts, without regard to any other circumstance. The 12th class requires more attention. When the stamina amount to above 20, a tyro will be apt to imagine that the plant belongs to the polyandria class. In reducing plants of this kind to their classes, particular regard must be had to the insertion of the stamina. If they are inserted into the calix or cup, the plant belongs to the icosandria class; if to the receptacle or basis of the flower, it belongs to the polyandria.

The 14th class is likewise in danger of being confounded with the 4th. In the 4th, the number of stamina is the same with that of the 14th. But, in the 14th, two of the stamina are uniformly much shorter than the other two; at the same time each particular stamen belonging to the different pairs stands directly opposite to one another.

The 15th class may be mistaken for the sixth, as they consist of the same number of stamina. But in the 15th, four of the stamina are uniformly longer than the other two; and these two are always opposite to each other.

ORDERS.

In the first thirteen classes, the orders, which are inferior divisions, and lead us a step nearer the genus, are taken from the pistils or female parts, in the same manner as the classes from the stamina: Monogynia, digynia, trigynia, tetragynia, *&c.* *i. e.* one, two, three, four, *&c.* female parts: When the pistils or female parts have no stalk or filament like the stamina, they are numbered by the stigmata or tops of the pistils, which in that case adhere to the capsule in the form of small protuberances, as may be observed in the flowers of the poppy, *&c.*

The orders of the 14th class are derived from a different source. The plants belonging to it have their seeds either inclosed in a capsule, or altogether uncovered. Hence they naturally admit of a division into the following orders, *viz.* *gymnospermia*, comprehending such as have naked seeds; and *angiospermia*, which comprehends such as have their seeds covered, or inclosed in a capsule.

The 15th class is divided into two orders, *viz.* the *siliculosa*, or those which have a short siliqua or pod; and the *siliquosa*, or those which have a longer siliqua.

The orders of the 16th, 17th, 18th, and 20th classes, are taken from the number of stamina, *e. g.* monodelphia pentandria, decandria, polyandria, *&c.*

The Syngenesia, or 19th class, consists of plants whose flowers are compounded of a great number of small flowers or floscules inclosed in one common calix. The orders of this class are,

Polygamia æqualis, or such whose floscules are all furnished with stamina and pistils.

Polygamia spuria, comprehends those which have hermaphrodite floscules in the disk, and female floscules in the margin. This circumstance is made the foundation of the three following orders. 1. *Polygamia superflua*, includes all those whose hermaphrodite flowers in the disk are furnished with stigmata, and bear seed; and whose female flowers in the radius likewise produce seeds. 2. *Polygamia frustranea*, include such as have hermahprodite seed-bearing floscules in the disk; but whose floscules in the radius, having no stigmata, are barren. 3. *Polygamia necessaria*, is the reverse of the former: The hermaphrodite flowers in the disk want stigmata, and are barren; but the female floscules in the radius are furnished with stigmata, and produce seeds.

Polygamia segregata, many floscules inclosed in one common calix, and each of the floscules likewise furnished with a perianthium proper to itself.

Monogamia, this order consists only of seven genera, *viz.* the strumphia, seriphium, corymbium, jasione, lobelia, viola, and impatiens; none of which have properly compound flowers, but are ranked under this class purely from the circumstance of having their stamina united by the antheræ.

The orders of the 21st class are partly taken from the number of stamina, and partly from the names and characters peculiar to some of the other classes, *e. g.* monœcia triandria, monœcia syngenesia, monœcia gynandria.

The orders of the 23d are all taken from classical characters, *e. g.* polygamia monœcia, polygamia diœcia, and polygamia triœcia.

The 24th, or Cryptogamia class, is divided into the four following orders: 1. *Filices*, comprehending all plants that bear their seed in the back or edges of the leaf, and those that are called *capillary plants*. 2. *Musci*, which comprehends all the moss kind. 3. *Algæ*, including the lichens, fuci, and many others whose parts of fructification are either altogether invisible or exceedingly obscure. 4. *Fungi*, comprehending all the mushroom tribe.

Having thus explained the method of reducing plants to their classes and orders, we shall proceed to inform the young botanist how to investigate the genus. This depends upon minuter distinctions, and requires more attention. But it is impossible to investigate the genera, without being previously acquainted with a considerable number of terms. All the terms necessary for this purpose belong to the parts of fructification. To attempt to give an idea by words of the parts to which particular terms are applied, would not only be difficult, but, in a great measure, useless, especially to such as are totally ignorant of botany. We shall therefore give a list of the terms themselves, with proper references to the figures of the things signified by them, which will both be shorter, and more intelligible than the most accurate description that language is capable of.

List of Terms belonging to the Flowers and Parts of Fructification. See Plate LIV.

Fig. 1. *Spatha*, a species of calix opening longitudinally when the flower breaks through it.

2. *Spadix*, a species of receptacle peculiar to palm-trees, which consists of fruit-bearing branches included in a spatha.

3. *a*,

Fig.

3. a, *Gluma*, another ſpecies of calix, belonging chiefly to graſſes and corns, and conſiſts of different valves; b, *ariſta*, or awn.

4. a a, *Umbella univerſalis*, comprehends the whole flowers, *&c.* ariſing from a common centre, and reſembling a large fan. b, *Umbella partialis*, or a ſmaller parcel of the flowers, *&c.* reſembling a ſmall fan. c c, *Involucrum univerſale*, a ſpecies of calix in which the whole flowers were incloſed before their blowing. d d, *Involucrum partiale*, a leſſer calix, which includes a ſmaller bundle of flowers, and which, before their blowing, is incloſed in the involucrum univerſale. Examples of theſe are found in the hemlock, carrot, *&c.*

5. c, *Calyptra*; b, *operculum*; a, *capitulum*. Theſe terms are peculiar to moſſes.

6. *Amentum*, a ſpecies of calix, *e. g.* in the willow, birch-tree, *&c.*

7. *Strobilus*, a pericarpium or capſule compoſed of an amentum, an example of which occurs in the magnolia.

8. *Fungi*. a, *Pileus*; b, *volva*; c, *ſtipes*. Theſe two are moſtly applied to the parts of muſhrooms.

9. a, *Receptaculum commune nudum*, the common receptacle, or baſe of the flower, when the ſtamina, piſtil, capſule, *&c.* are taken off.

10. *Receptaculum commune paleis imbricatum*, or common receptacle imbricated or tiled with paleæ, or membranaceous lamellæ.

11. *Corollæ monopetalæ*. a, *Tubus*; b, *limbus*; *i. e.* *a*, the tube; *b*, the edge or margin of a monopetalous corolla. The corolla ſignifies the flower-leaf, when it conſiſts but of one, and the whole flower-leaves, when it conſiſts of more.

12. Is a flower laid in a proper poſition for ſhewing its different parts. a, *Germen*, which includes the ſeeds and capſule in which they are incloſed; b, *ſtylus*, which is a continuation of the germen; c, *ſtigma*, or top of the ſtylus; d d d d d d, *filamenta*, or threads; e e e e e, *antheræ*. The filamenta and antheræ, conſidered as a whole, are called *ſtamina*; and the germen, ſtylus, and ſtigma, as a whole, are called *piſtillum*. f f f f f, *Petala*, or flower-leaves.

13. a, The *ungues*, or claws; b, the *laminæ*, or plates of a polypetalous corolla, or corolla conſiſting of ſeveral flower-leaves.

14. a, *Nectarium campanulatum in narciſſa*, or bell-ſhaped nectarium of the narciſſus. Nectarium is applied to every glandular part of a flower which ſecerns a ſweet juice. Their ſtructure is very different in different plants.

15. *Nectaria cornuta in aconita*, horned nectaria of the monkſhood.

16. *Horned nectarium* in the calix of the tropœolus.

17. a a a a, *Nectarium in parnaſſia*; the nectaria of the parnaſſia graſs are ſix in number, each of which have thirteen ſtyli, with round buttons on their tops.

18. a, *Perianthium*, that ſpecies of calix which is contiguous to the fructification; b, *germen*; c, *ſtylus*; d, *ſtigma*; e e, *filamenta*; f f, *antheræ dehiſcentes*, or antheræ ſhedding the pollen or duſt; g, *anthera integra*, i. e. the appearance of the anthera before it ſheds the pollen.

19. *a*, The *filament*, and *b*, the *anthera*, ſeparated from the flower.

20. *a*, One grain of the *pollen* magnified by a microſcope; b, *halitus elaſticus*, i. e. an elaſtic aura ſuppoſed to be neceſſary for impregnating the ſeeds.

21. a, *Germen*; b, *ſtylus*; c c, *ſtigma*.

22. *Folliculus*, i. e. a pericarpium conſiſting only of one valve, opening longitudinally, and in which the ſeeds do not adhere to the ſuture, but are incloſed in a particular receptacle *a*.

23. *Legumen*, is a double-valved pericarpium, having the ſeeds fixed only to one of the ſutures *a a*.

24. *Siliqua*, is a double-valved pericarpium with the ſeeds fixed to both ſutures or margins *a b*.

25. *Pomum*, a pericarpium without any valve, but made up of a pulpy ſubſtance, and containing a capſule in which the ſeeds are incloſed, as in the apple, *&c.* a, The *pericarpium*; b, the *capſule*, or ſeed-caſe.

26. a, *Drupa*, or a pericarpium containing a nut or ſtone, and having no valve, *e. g.* plumbs, *&c.* b, the *nucleus*, or ſtone.

27. *Bacca*, or berry, is a pericarpium containing naked ſeeds diſperſed through the pulpy part.

28. *Capſula apice dehiſcens*, a capſule opening at the top to allow the ſeeds to fall out.

29. Four capſules included in a common pericarpium. *a a*, The valves; *b b*, the diſſepimentum, or partition which ſeparates the different ſeed-capſules from one another; *c*, columella, or central column by which the capſules are connected.

30. A capſule cut open longitudinally, to ſhow the receptacle of the ſeeds.

31. *Pappus*, a kind of corona or crown which is either hairy or penniform, and connected to the ſeeds of ſome plants, by means of which they are blown about by the wind. a, *Pappus piloſus*, or pappus reſembling a hair; b, *pappus plumoſis*, or feathered pappus; c, *ſemen*; d, *ſtipes*. The dandelion, and many plants of the ſyngeneſia claſs, afford examples of theſe parts.

Terms belonging to the Pedunculus or Footſtalks of Flowers.

32. *Corymbus*, i. e. flowers upon alternate pedunculi and foot-ſtalks, elevated proportionally above each other.

33. *Racemus*, a pedunculus or foot-ſtalk furniſhed with lateral branches.

34. *Spica*, alternate ſeſſile flowers [i. e. flowers without any particular foot-ſtalk, but inſerted directly into one common to the whole], upon a common foot-ſtalk, as in the ſcirpus.

35. *Verticillus*. This term is applied to ſuch plants as have cluſters of flowers at different diſtances ſurrounding the caulis or ſtem; as in ſeveral ſpecies of mint.

36. *Panicula*, i. e. flowers placed ſparſely upon ſeparate foot-ſtalks, as in oats, *&c.*

When theſe terms are underſtood, the genus may be eaſily inveſtigated. But in order ſtill further to aſſiſt the young botaniſt, we ſhall give a ſyſtematic deſcription of a few common plants belonging to different claſſes.

DIANDRIA MONOGYNIA.

Veronica, or Speedwell.

The Calix is a perianthium (18), divided into four parts or segments, and persistent (i. e. does not fall off till the seeds are ripe); the segments are sharp and lance-shaped.

The Corolla (11) consists of one rotated petal; The *tubus* (11) is about the same length with the calix; the *limbus* (11) is plane, and divided in four oval segments, the lowest of which is narrower than the rest, and the one immediately opposite broader.

The Stamina (12) are two, narrower below, and inclined upwards; the antheræ (12) are oblong.

The Pistillum (12) has a compressed germen (12), a filiform or thread-like stylus (12), about the same length with the stamina, and a little declined to one side: The stigma (12) is simple.

The Pericarpium (12) is a heart-shaped capsule, compressed at the top, and having two cells or partitions, and four valves.

The Seeds are roundish and numerous.

ICOSANDRIA POLYGAMIA.

Fragaria, or Strawberry.

The Calix is a perianthium, consisting of one plain leaf, divided into ten segments, each alternately narrower.

The Corolla has five roundish open petals inserted into the calix.

The Stamina are twenty in number, subulated or tapering, shorter than the corolla, and inserted into the calix. The antheræ are lunulated, or shaped like a crescent.

The Pistillum consists of many small germina, collected into a little head or knob. The styli are simple, and inserted into the sides of their respective germina. The stigmata are simple.

The Pericarpium is wanting in this plant. But the common receptacle of the seeds, which supplies the place of a pericarpium, is a roundish oval berry, plain at the base, pretty large, soft, pulpy, coloured, and deciduous, *i.* e. falls off before the seeds be ripe.

The Seeds are small, pointed, very numerous, and dispersed through the superficial part of the receptacle.

DIDYNAMIA ANGIOSPERMIA.

Digitalis, or Fox-glove.

The Calix is a perianthium, divided into four deep cut segments, which are roundish, sharp at the top, persistent, and the highest one is narrower than the rest.

The Corolla consists of one bell-shaped petal; the tubus is large, open, ventricose or bellied at the backside; the base is cylindrical and narrow: The limbus is small, and divided into four segments; the superior segment is more open and more emarginated than the rest.

The Stamina are four, subulated (44), inserted into the base of the corolla, and inclined to the same side; two of them are longer than the other two: The antheræ are divided into two parts, and pointed at the top.

The Pistillum consists of a germen sharp at the top, a simple stylus situate like the stamina, and an acute stigma.

The Pericarpium has an oval capsule, of the same length with the calix, sharp at the top, having two cells and two valves which burst open at both sides.

The Seeds are many and small.

TETRADYNAMIA SILIQUOSA.

Sinapis, or Mustard.

The Calix is a perianthium consisting of four open or spreading leaves; the leaves are linear (43), concave, furrowed, disposed in the form of a cross, and deciduous.

The Corolla consists of four cruciform petals: The petals are roundish, plain, open, entire or not emarginated, with erect linear ungues (13) scarcely so long as the calix.

The Nectaria (14, *&c.*), or *glandulæ nectariferæ*, are four, of an oval figure, one of which is situate on each side betwixt the short stamina and stylus, and likewise one on each side between the long stamina and the calix.

The Stamina have six subulated, erect filaments, two of which are of the same length with the calix, and always opposite to each other, and the other four are uniformly longer: The *antheræ* are erect, and sharp at the top.

The Pistillum has a cylindrical germen; the stylus is of the same length with the germen, and the same height with the stamina; the stigma is entire, with a little knob or button.

The Pericarpium is an oblong, scabrous, double-celled, two-valved pod, gibbous, and full of little protuberances on the under parts: The dissepimentum (29) is large, compressed, and often twice the length of the valves.

The Seeds are many and round.

MONODELPHIA POLYANDRIA.

Malva, or Common Mallow.

The Calix is a double perianthium: The exterior one consists of three lanceolated, loose, persistent leaves; the interior has but one large, broad, persistent leaf, divided into five segments.

The Corolla has five plain leaves, united at the base, heart-shaped, and premorse (54).

The Stamina consist of numerous filaments, united into a cylindrical form below, loose above, and inserted into the corolla: The antheræ are kidney-shaped.

The Pistillum has an orbicular germen, a cylindrical, short stylus, and many bristly stigmata of an equal length with the stylus.

The Pericarpium consists of several distinct capsules joined by an articulation, resembling a depressed globe, and

and opening from within when ripe: The receptaculum is a kind of column binding the capſules together.

The Seeds are ſolitary, and kidney-ſhaped.

SYNGENESIA POLYGAMIA AEQUALIS.

Leontodon, or Dandelion.

The *common* Calix is oblong, and imbricated: The *interior ſcales* are linear, parallel, equal, and open at the top; the *exterior ſcales* are fewer in number, and frequently reflected at the baſe.

The *compound* Corolla is uniform and imbricated.

The *ſmall hermaphrodite corollæ* are very numerous and equal.

The *corolla* proper to each floſcule conſiſts of one ligulated (*i. e.* plain and expanded outwards), linear, truncated (*i. e.* terminated by a tranſverſe line), and five-teethed petal.

The Stamina conſiſt of five very ſmall capillary filaments: The antheræ are connected together, and form a cylindrical tube.

The Germen of the *piſtillum* is ſituate below the proper corolla. The ſtylus is filiforme, and nearly of the ſame length with the corolla: The ſtigmata are two, and turned back in a ſpiral form.

This plant has no *pericarpium*.

The Seeds are ſolitary, oblong, rough, and terminated by a long pappous ſtipes (31).

The receptacle, or common baſe of the floſcules (9), is naked, and full of ſmall hollow points.

GYNANDRIA PENTANDRIA.

Passiflora, or Passion-flower.

The Calix is a perianthium conſiſting of five plain, coloured leaves, ſimilar to thoſe of the corolla.

The Corolla conſiſts of five plain obtuſe ſemi-lanceolated leaves, of the ſame magnitude and figure with thoſe of the calix.

The *nectarium* is a triple corona, the exterior of which is longeſt, ſurrounding the ſtylus within the petals, and ſtraitened above.

The Stamina are five, ſubulated, open, and connected to the ſtylus at the baſe of the germen: The antheræ are oblong, obtuſe, and incumbent.

The Pistillum conſiſts of an erect cylindrical ſtylus, upon the top of which an oval germen is placed: The ſtyli are three, thicker, and wider above: The ſtigmata are roundiſh knobs.

The Pericarpium is a fleſhy, ſuboval, one-celled berry, reſting upon the ſtyles.

The Seeds are numerous, oval, and each of them incloſed in a ſmall membrane.

MONOECIA TETRANDRIA.

Urtica, or Common Nettle.

The Calix of the male flowers is a four-leaved perianthium; the leaves are roundiſh, concave, and obtuſe.

The Corolla has no petals; but there is a ſmall urceolated (*i. e.* an inflated ſkin, gibbous on each ſide) nectarium in the centre of the flower.

The Stamina conſiſts of four ſubulated open filaments, of an equal length with the calix, and one of them is placed between each leaf of the calix: The *antheræ* have no cells.

The Calix of the female flowers is a double-valved, oval, concave, erect, perſiſtent perianthium.

The Corolla is wanting.

The Pistillum has an oval germen, no ſtylus, and a downy ſtigma.

They have no *pericarpium*.

The Seed is ſingle, oval, ſhining, and a little compreſſed.

Theſe examples will not only illuſtrate moſt of the generic terms, but will likewiſe fix them in the mind more ſucceſsfully than any formal explanation. A careful peruſal of them will enable any perſon to underſtand the deſcriptions in the *Genera Plantarum* of Linnæus, although he ſhould not be much acquainted with the Latin language.

But the young botaniſt, after advancing this far, muſt ſtill be conducted a ſtep further. Though he may be able to reduce plants to their claſſes, orders, and genera, he is hitherto totally ignorant of the ſpecific characters. Before he be able to inveſtigate the ſpecies, he muſt again ſubmit to learn a conſiderable nnmber of terms neceſſary for that purpoſe.

Liſt of Terms neceſſary for inveſtigating the Species of Plants.

Simple Leaves.

Fig.

37. *Orbiculatum*, globular.
38. *Subrotundum*, roundiſh.
39. *Ovatum*, ſhaped like an egg.
40. *Ovale*, oval or elliptical.
41. *Oblongum*, oblong.
42. *Lanceolatum*, in the form of a dart, or tapering on each ſide to a point.
43. *Lineare*, like a line, or of the ſame breadth and thickneſs throughout.
44. *Subulatum*, tapering to a point, like an awl.
45. *Reniforme*, ſhaped like a kidney.
46. *Cordatum*, like a heart.
47. *Lunulatum*, reſembling a creſcent or half-moon.
48. *Triangulare*, three-cornered.
49. *Sagittatum*, like an arrow.
50. *Cordato-ſagittatum*, reſembling both a heart and an arrow.
51. *Haſtatum*, like a ſpear or lance.
52. *Fiſſum*, cut in at the top.
53. *Tribolum*, conſiſting of three (55) lobes.
54. *Præmorſum*, *i. e.* as if a piece were bit out of the fore-part of the leaf.
55. *Lobatum*, conſiſting of lobes, or ſegments cut to the middle of the leaf, and convex at the edges.
56. *Quinangulare*, conſiſting of five angles.

57. *Eroſum*,

Fig.

57. *Erosum*, as if eroded or eat irregularly by some corrosive substance.
58. *Palmatum*, resembling a hand.
59. *Pinnatum*, divided into pieces resembling fins.
60. *Laciniatum*, with many cuts or indentures in the margin.
61. *Sinuatim*, having wide sinuses or hollows in the margin.
62. *Dentato-sinuatum*, having sinuses and divisions resembling teeth.
63. *Retrorsum sinuatum*, hollowed and bent backwards.
64. *Partitum*, when the divisions or segments reach near the base of the leaf.
65. *Repandum*, a waving but undivided margin.
66. *Dentatum*, teethed, *i. e.* when the tops of the segments are remote from each other.
67. *Serratum*, when the segments uniformly incline to the extremity.
68. *Duplicato-serratum*, doubly serrated, *i. e.* when the lesser segments incline to the extremities of the larger ones.
69. *Duplicato-crenatum*, doubly crenated, (74)
70. *Cartilagineum*, when the margin of the leaf has a cartilaginous or gristly texture.
71. *Acute-crenatum*, sharp segments having no determinate inclination to either extremity.
72. *Obtuse-crenatum*, the same with the above, only the segments are blunt.
73. *Plicatum*, plaited, or consisting of regular folds.
74. *Crenatum*, segments having no inclination to either extremity.
75. *Crispum*, when the margin is larger than the disc, and formed into a kind of waves.
76. *Obtusum*, blunt at the top.
77. *Acutum*, sharp, or pointed.
78. *Acuminatum*, when the leaf tapers to a sharp point at the top.
79. *Obtusum acumine*, having a short subulated point.
80. *Emarginatum acute*, having sharp divisions at the top of the leaf.
81. *Unciforme marginatum*, having wedge-shaped divisions at the top.
82. *Retusum*, having blunt sinuses.
83. *Pilosum*, covered with long distinct hairs.
84. *Tomentosum*, interwoven with soft hairs, and often of a white colour.
85. *Hispidum*, having brittle rough bristles diffusely scattered upon the disc of the leaf.
86. *Ciliatum*, having parallel bristles round the margin.
87. *Rugosum*, full of rugæ or wrinkles.
88. *Venosum*, having veins or nerves consisting of many ramifications.
89. *Nervosum*, when the veins or nerves are extended from the base to the top without any branches.
90. *Papillosum*, covered with vesicles, bladders, or hollow points.
91. *Linguiforme*, like a tongue, *i. e.* fleshy, linear, obtuse, convex below, and having frequently a cartilaginous margin.
92. *Acinaciforme*, resembling a kernel;—compressed, fleshy, having one edge narrow and convex, and the other thicker and more straight.

Fig.

93. *Dolabriforme*, resembling an ax;—compressed, roundish, gibbous on the outside, with a sharp edge, which is a little blunter below.
94. *Deltoides*, an irregular rhomboidal figure. See the leaf of the black poplar.
95. *Triquetrum*, having three plain sides.
96. *Canaliculatum*, having a deep longitudinal furrow.
97. *Sulcatum*, having several deep furrows.
98. *Teres*, cylindrical, or like a cylinder.
99. *Binatum*, when a simple petiolus has two leaves connected to its apex.
100. *Ternatum foliis sessilibus*, three sessile leaves (*i. e.* having no petioli) connected to one common petiolus.
101. *Ternatum foliolis petiolatis*, three leaves upon a common petiolus, each having at the same time a separate petiolus.
102. *Digitatum*, or resembling fingers, *i. e.* when a simple petiolus has two, three, four, or more leaves connected to its apex.
103. *Pedatum*, a bifid or forked petiolus, having small leaves connected to its interior side.
104. *Pinnatum cum impari*; small leaves connected to the sides of a simple petiolus, terminated by an odd leaf.
105. *Pinnatum abruptum*, neither terminated by an odd leaf nor a cirrhus.
106. ——— *alternatum*, when the small leaves rise higher and higher alternately upon the petiolus.
107. ——— *interrupte*, when the pinnated leaves are alternately larger and smaller.
108. ——— *cirrhosum*, when the common petiolus ends in a cirrhus.
109. ——— *conjugatum*, when the common petiolus has only two leaves connected.
110. ——— *decursive*, when the small leaves run along the petiolus.
111. ——— *articulate*, when the common petiolus is jointed.
112. *Lyratum*, like a harp, *i. e.* when the leaf is transversely divided into segments, the superior of which are larger than the inferior, and the inferior ones are more distant from each other.
113. *Biternatum*, or *duplicato-ternatum*, when the common petiolus has three ternated (100) leaves fixed to it. The epimedium is an example of this.
114. *Bipinnatum*, or *duplicato-pinnatum*, when the common petiolus gives off pinnated (104) petioli from its sides.
115. *Triternatum*, or *triplicato-ternatum*, when the common petiolus sends off from its sides three biternated (113) leaves.
116. *Tripinnatum sine impari*, when the common petiolus has three or more bipinnated (114) leaves fixed to its sides, not terminated by a single leaf.
117. ——— *cum impari*, the same with the former, only terminated by a single leaf.

Terms

Terms respecting the Determination of Leaves.

Fig.

118. *Inflexum*, when the leaves bend or arch upwards upon the caulis or ftem.
119. *Erectum*, when the leaves make a very acute angle with the caulis.
120. *Patens*. This term is applied to leaves which make a more obtufe angle with the caulis than the former.
121. *Horizontale*, when the leaves ftand at right angles with the caulis.
122. *Reclinatum*, or *reflexum*, when the leaf bends down, fo that the apex is lower than the bafe.
123. *Revolutum*, when both fides of the leaf are rolled backwards in a fpiral form.
124. *Seminale*, feed-leaves, or diffimilar leaves. They are the lobes of the feed, which in many plants arife entirely out of the ground, and are always the firft that appear above the furface. See AGRICULTURE, p. 41.
125. *Caulinum*, fuch as rife immediately from the caulis or ftem.
126. *Rameum*, fuch as arife from a branch of the caulis.
127. *Florale*, fuch as arife from the fame place with the flower.
128. *Peltatum*, when the petiolus is inferted, not into the edge or bafe, but into the difk of the leaf.
129. *Petiolatum*, when the petiolus is inferted into the margin of the bafe.
130. *Seffile*, when the leaf has no petiolus, but is immediately connected to the caulis.
131. *Decurrens*, when the bafe of a feffile (130) leaf is extended downwards along the caulis; as in the verbefina, carduus, *&c.*
132. *Amplexicaule*, when the bafe of the leaf embraces the caulis on all fides.
133. *Perfoliatum*, when the bafe of the leaf entirely furrounds the caulis, fo that the caulis feems to perforate the leaf.
134. *Comatum*, when the oppofite leaves run into one another, and furround the caulis, as in the eupatorium.
135. *Vaginans*, when the bafe of the leaf forms a cylindrical tube invefting the caulis.
136. *Articulatum*, in the form of joints, *i. e.* when one leaf arifes from the apex of another.
137. *Stellata*, radiated like a ftar, *i. e.* when more than two leaves furround a verticillated (35) caulis.
138. *Quaterna, quina, fena*, &c. are fpecies of ftellated (137) leaves, when there are four, five, or fix, *&c.* leaves furrounding the caulis.
139. *Oppofita*, when the leaves of the caulis are exactly oppofite to one another.
140. *Alterna*, when the leaves rife alternately higher upon the caulis.
141. *Acerofa*, linear, perfiftent leaves, as in the pinus or fir-tree, *&c.*

Fig.

142. *Imbricata*, when the leaves reft upon one another like tiles on a roof.
143. *Fafciculata*, when many leaves rife from the fame point, as in the larynx.
144. *Frons*. This term is applied to a fpecies of trunk, which confifts of branches and leaves, and fometimes the fructification, all united together: It is peculiar to the filices, or ferns, and the palmæ.
145. *Spathulatum folium*, is a roundifh leaf, with a narrow linear bafe.
146. *Parabolicum folium*, like a parabola, *i. e.* having its longitudinal diameter longer than the tranfverfe, and growing narrower from the bafe till it terminates in an oval figure.

Terms relating to the Caules or ftems. Plate LVII.

147. *Squamofus culmus*. The *culmus* is a trunk or ftem peculiar to graffes; and *fquamofus culmus* is a fcaly culmus.
148. *Repens caulis*. The *caulis* or ftem is a fpecies of trunk peculiar to herbaceous plants, and fupports the leaves or parts of fructification: *Repens caulis* is a ftem which gives out fmall roots on every fide, as it runs along the furface of the ground, or upon another plant.
149. *Scapus*, is a fpecies of trunk which fupports the parts of fructification, but has no leaves.
150. *Articulatus culmus*, a culmus (147) with many joints.
151. *Volubilis caulis*, a caulis (148) which runs in a fpiral form upon the trunk or branch of another plant, *&c.*
152. *Dichotomus caulis*, a caulis (145) uniformly dividing into branches.
153. *Brachiatus caulis*, a caulis having oppofite decuffating branches, refembling arms.

Terms relating to the Fulcra or fupports of Leaves.

154. a, *Cirrhus*, a fpiral thread which connects the plant to any other body. b, *Stipulæ*, or little fcales at the bafe of the petiolus or pedunculus. c, *Glandulæ concavæ*, fmall hollow glands for fecreting a liquor.
155. a, *Glandulæ pedicellatæ*, fmall glands, each fupported by a pedunculus.
156. a, *Bractea*, or flower-leaf, which differs in fhape from the other leaves of the plant *b*.
157. a, *Spina fimplex*, a fimple thorn or prickle. b, *Spina triplex*, or three prickles proceeding from ne. *Spina* is applied to fuch thorns as are protruded from the wood of the plant.
158. *Aculeus fimplex*. Aculeus is a prickle not protruded from the wood, but only fixed to the bark. It is faid to be *fimple*, when it rifes fingle.
159. *Aculeus triplex*, a triple aculeus (158).
160. *Oppofita folia*, or oppofite leaves. a, The *axilla* or arm-pit.

Terms relating to Roots.

Fig.
161. *Bulbus squamosus*, when the root is composed of imbricated or tiled scales or plates, as in the lily-root.
162. *Bulbus solidus*, consisting of a solid substance.
163. *Bulbus tunicatus*, consisting of coats lying above one another, as in the onion.
164. *Tuberosa radix*, a root consisting of a great many little knots, as in the filipendula.
165. *Fusiformis radix*, like a spindle, *i. e.* oblong, thick, and tapering to a point below, as in the root of the carrot.
166. *Ramosa radix*, having many lateral branches.
167. *Repens radix*, a root which creeps horizontally, and sends off every where smaller roots at different distances.

These are the principal terms necessary for understanding Linnæus's description of the specific characters of plants.—To make the reader acquainted with the manner in which these terms are used, we shall give a few examples.

Class II. DIANDRIA.
Order, MONOGYNIA.
Genus, Veronica, or Speedwell.
Species, Veronica *arvensis*, has solitary flowers, cut, sessile (130), and cordated (46) leaves.
Veronica *agrestis*, has solitary flowers, cut, cordated (46), and petiolated (129) leaves.

Class XVI. MONODELPHIA.
Order, POLYGYNIA.
Genus, Malva, or Mallow.
Species, Malva *spicata*, has tomentose (84), crenated (74), and cordated (46) leaves, and oblong hairy spicæ (34).
Malva *sylvestris*, has an erect (119) herbaceous caulis (148), with acute (74), seven-lobed (50) leaves, and hairy pedunculi and petioli (129).

Class XIX. SYNGENESIA.
Order, POLYGAMIA ÆQUALIS.
Genus, Carduus, or Thistle.
Species, Carduus *helenioides*, or *melancholy thistle*, has lanceolated (42), teethed (66), amplexicaule (132) leaves, with unequal ciliated (86) small spines (158).

Class XXIV. CRYPTOGAMIA.
Order, FILICES.
Genus, Asplenium, or Maidenhair.
Species, Asplenium *trichomanes*, has a pinnated (104) frons (144); the pinnæ (104) are roundish (38) and crenated (74).

To these examples we shall add a complete description of a plant reduced to its class, order, genus, and species, with figures of all the parts necessary for that purpose.

Rheum Palmatum, *or True Rhubarb. See* Plate LVIII.

The flower of this plant has no Calix.

The Corolla *dd*, consists of one petal, narrower at the base, not perforated, and divided in the margin into six obtuse segments, one less and one larger alternately; the petal is marcescent, *i. e.* decays, but does not fall off till the seeds be ripe.

The Stamina *e e*, consist of nine capillary filaments inserted into the corolla, and about the same length with it. The *antheræ* are didymous, (*i. e.* appear to be double), oblong, and obtuse.

The Pistillum *f*, has a short three-sided germen. It can hardly be said to have any styli; but has three reflected, plumose stigmata.

The Pericarpium is wanting.

Each flower contains but one large, three-sided, acute seed g, with a membranaceous edge.

The number of stamina determines this plant to belong to the Enneandria class; and the number of Stigmata fixes its order to be Trigynia. The other parts of the above description clearly demonstrate the genus to be the Rheum or Rubarb, and sufficiently distinguish it from the Laurus, Tinus, Cassyta, and Butomus, the only other genera belonging to this class.

The Specific mark is taken from the leaves, which are palmated (58), and sharp and tapering at the points. There are but five species of Rheum, none of whose leaves are palmated, except the species now described.

But though the above description be sufficient for ascertaining the genus and species of this valuable plant, there are other reasons for giving a complete botanical description of the whole parts of it. The true rhubarb, though of the most extensive use in medicine, was never known in this country till the year 1762, when Dr Mounsey brought some seeds from Russia, and gave them to Dr Hope professor of medicine and botany in Edinburgh. Dr Hope sowed them in the botanical garden, and collected about 30 seeds from one of the plants, which rose to eight feet in height. This plant is now propagating in the botanic garden, in the garden of Sir Alexander Dick, and many other gardens in Scotland. The root is found, by repeated trials, to be equally powerful in its operation as the best foreign rhubarb; and we have the greatest reason to hope, that in a short time this plant will be so universally cultivated as to prevent the future importation of it. The first botanic description we have of the true rhubarb was published by Dr Hope in the philosophical transactions for the year 1765*; which we shall translate into English.

* Vid. Phil. Transf. for the year 1765.

The

The ROOT *a*, is of the branchy kind, and perennial.

The LEAVES of (which *b* in the plate is an outline) are about sixteen in number, grow near the root, about two feet long, and are furnished with petioli or foot-stalks. —The petioli are about a foot long, cylindrical, plane above, smooth, of a green colour, but in some places interspersed with small, narrow, purple spots; at the base of the leaf, the petiolus terminates in three or five large nerves or ribs, which are prominent above; the leaves are ovated, deep cut, with sharp lacinia or segments; the superior part of the base is green, the inferior of a whitish green, and both are a little rough.

The CAULIS or STEM is erect, somewhat cylindrical, fistulous or hollow within, jointed, sheathed, rough, striated, about eight feet high, and about two inches over near the base. It has fourteen joints, each of which, from the base to the ninth joint, is furnished with a reflected leaf, placed alternately, gradually diminishing as they rise higher, and the petiolus forms a kind of sheath, which embraces the stem.

The PEDUNCULI or FOOT-STALKS of the flowers, which are numerous, arise from the alæ or arm-pits of the leaves, are almost erect, unequal, striated, cylindrical, plainish at the base, and out of their sides other foot-stalks arise, to be distributed in the same manner. *c*, is a flowering branch separated from the stem.

The TASTE, ODOUR, and COLOUR of the ROOT are precisely the same with those of the foreign rhubarb.

The TASTE of the FLOWERS is astringent, herbaceous and subacid; they have no sensible smell.

The TASTE of the LEAVES is bitterish, astringent, and herbaceous; the taste of the RIBS or NERVES is acid, bitterish, and very ungrateful;—the taste of the STEM is a little sour.

WE have now pretty fully explained the method of reducing plants to classes, orders, genera, and species, according to the sexual system of Linnæus. The manner in which this explanation has been executed was suggested by the difficulties which naturally occur to a person unacquainted both with the subject and the system. Although this manner has not, so far as we know, been hitherto attempted, we hope it will not be the less acceptable to the public, especially as it is likely to be more useful to the botanical student.

It only now remains to make the reader more fully acquainted with the origin and nature of the sexual system.

SECT. III. OF THE SEXES OF PLANTS.

AS many philosophers and botanists deny that such a thing as the distinction of sexes takes place in vegetables, it will be necessary to give a narration of the arguments employed by both parties on this subject. We shall begin with the arguments in favour of the sexes.

LINNÆUS, like every person attached to a particular doctrine or theory, is at great pains in tracing the notion of sexes in plants to the remotest periods of antiquity. He informs us, that Empedocles, Anaxagoras, and other ancient philosophers, not only attributed the distinction of sexes to plants, but maintained that they were capable of perceiving pleasure and pain.

Hippocrates and Theophrastus are next introduced as distinguishing the conyza, the abies, the filix, *&c.* into male and female. The latter of these writers affirms, that the fruit of the female palm will not germinate unless the pollen of the male be shaked over the spatha of the female, previous to the ripening of the seed.

Dioscorides takes notice of a male and female mandragora, mercurialis, cistus, *&c.*

Pliny does not confine his views of sex to animals, but exclaims, that every thing this earth produces is characterized by the distinction of sex.

From the days of Pliny to those of Cæsalpinus, who lived in the 16th century, the analogy between the vegetable and animal seems to have been entirely neglected. Cæsalpinus tells us, that the males of the oxycedrus, taxus, mercurialis, urtica, and cannabis, are barren; and that the females of these plants only bear fruit.

After Cæsalpinus, we find Dr Grew and Sir Thomas Millington engaged in a conversation concerning the utility of the stamina and styli of plants. The result of this conversation was the mutual agreement of these two eminent naturalists, that the stamina and styli of vegetables were analogous to the organs of generation in animals, and that they were adapted by nature to answer the same purposes. Dr Grew, in his anatomy of plants, after enumerating the analogies between plants and animals, concludes, that the pollen probably emits certain *vivific* effluvia, which may serve for the impregnation of the seeds.

Mr Ray gave a further sanction to the doctrine of sexes, by concurring with Grew, and adding some further illustrations from analogy.

In the year 1695, Camerarius attempted to prove the sexes of plants. But, as he trusted solely to the palm-tree, and withal seemed to be doubtful as to the authenticity of the fact, he cannot be considered as having done any thing in confirmation of the sexual hypothesis.

Mr Morland, in the year 1703, adopted the same hypothesis; but gave it a new modification, by supposing that the pollen contained the seminal plant in miniature; and consequently, that one pollen at least behoved to be conveyed into every separate seed before it could be properly impregnated. Analogy and the structure of the parts are the only arguments he employs.

Some years after this, Mr Geoffroy wrote a treatise on the sexes of plants: But as he advanced nothing new, we shall take no further notice of him.

Vaillant, in the 1717, judiciously considering that the canal in the stylus of most plants was too narrow to admit the pollen itself, republished Dr Grew's theory of impregnation by means of a subtile seminal aura.

These

These are the sentiments of the principal botanists with regard to the generation of plants, till the celebrated Linnæus made his appearance as a botanical writer, who has extended the idea so far as to compose a complete system upon it.

Although Linnæus can have no claim to the supposed discovery of the sexual hypothesis, his being precisely the same with that of Dr Grew; yet, as he is the chief supporter and improver of this doctrine, we shall give a succinct narration of the arguments he makes use of in order to prove that vegetables propagate their species by a regular commerce of sexes.

In a treatise, intitled, *Sponsalia Plantarum*, published as an inaugural dissertation by Wahlbom, in the first volume of the *Amœnitates Academicæ*, all the arguments made use of by Linnæus in his *Fundamenta Botanica* and other works, are collected and arranged in one view. But as Wahlbom honestly attributes all the merit of this dissertation to his great master, we shall here drop his name altogether, and give the arguments as the property of Linnæus, by whom they were originally employed.

Linnæus, then, first attempts to show, that vegetables are endowed with a certain degree of animal life; and, secondly, that they propagate their species in a manner similar to that of animals.

" That vegetables are really animated beings," says he, " must be obvious at first sight; because they possess all the properties contained in that accurate definition of life laid down by the great Dr Harvey, namely, *Vita est spontanea propulsio humorum*. But universal experience teaches, that vegetables propel humours or juices: Hence it is plain that vegetables must be endowed with a certain degrees of animal life."

Not trusting solely to a syllogism founded on a definition, Linnæus proceeds to support the life of vegetables by arguments drawn from the following particulars in their œconomy; the first of which he intitles

" *Nutritio.*—The very idea of nutrition implies a propulsion of humours, and, of course, the idea of life. But vegetables derive their nourishment from the earth, air, *&c.* and consequently must be considered as living creatures.

" 2. *Ætas.*—Every animal must not only begin to exist, and have that existence dissolved by death, but must likewise pass through a number of intermediate changes in its appearance and affections. *Infancy, youth, manhood, old age,* are characterised by *imbecillity, beauty, fertility, dotage*; are not all these vicissitudes conspicuous in the vegetable world? Weak and tender in *infancy*; beautiful and salacious in *youth*; grave, robust, and fruitful in *manhood*; and when *old age* approaches, the head droops, the springs of life dry up, and, in fine, the poor tottering vegetable returns to that *dust* from whence it sprung.

" 3. *Motus.*—No inanimate body is capable of self-motion. Whatever moves spontaneously is endowed with a living principle; for motion depends on the spontaneous propulsion of humours, and where-ever there is a spontaneous propulsion of humours, there also is life. That vegetables are capable of motion is evident from the following facts: Plants, when confined within doors, always bend towards the light, and some of them even attempt to make their escape by the windows. The flowers of many plants, especially those of the syngenesia class, pursue the sun from east to west, rejoicing in his beams. Who then can deny that vegetables are possessed of living and self-moving powers?

" 4. *Morbus.*—The term *disease* means nothing more than a certain corruption of life: It is well known, that vegetables are subject to diseases as well as animals: When over-heated, they turn thirsty, languish, and fall to the ground: When too cold, they are tormented with the chilblain, and not unfrequently *expire:* They are sometimes afflicted with cancers; and every plant is infested with lice peculiar to its species.

" 5. *Mors.*—Death is opposed to life, the former being only a privation of the latter. Experience shows, that every living creature must die. But, as vegetables are daily cut off by internal diseases and external injuries; as they are subject to death from the attacks of hunger, thirst, heat, cold, *&c.* with what propriety could vegetables be thus said to *die*, unless we allow that they previously *lived?*

" 6. *Anatomia.*—Under this article we are referred to Malpighius and Grew for the organic fibres, membranes, canals, vesicles, *&c.* of plants, as additional proofs of their living powers.

" 7. *Organizatio.*—Vegetables not only propel humours, but also prepare and secern a number of different juices for the fruit, the nectar, *&c.* analagous to the various secretions in animal bodies."

From these facts and observations, Linnæus concludes, that plants are unquestionably endowed with life as well as animals; and then proceeds in the following manner to shew how these animated vegetables propagate their species.

After discussing the long exploded doctrine of equivocal generation, he lays hold of another maxim of Dr Harvey, *viz. Omne vivum ex ovo.*—" It being fully evident," says he, " from the foregoing chain of reasoning, that vegetables are endowed with life, it necessarily follows, agreeable to this maxim of Harvey's, that every vegetable must in like manner derive its existence from an *egg*. But as vegetables proceed from eggs, and as it is the distinguishing property of an egg to give birth to a being similar to that which produced it, the seeds must of course be the *eggs* of vegetables.

" Granting then that the seeds of vegetables are intended by nature to answer the same end as the eggs of animals, and considering at the same time that no egg can be fecundated without receiving an impregnation from the male, it follows, that the seed or eggs of vegetables cannot be fecundated by any other means. Hence also the necessity of vegetables being provided with organs of generation. But where are these organs situated? The answer is easy:—We have already found impregnated seeds within the flowers of plants; and it is natural to expect that the *genitalia* should not be at a great distance. Now, as *copulation* always precedes *birth*, and every *flower* precedes the *fruit*, the *generating faculty* must be ascribed to the *flower*, and the *birth* to the *fruit*. Again, as the *antheræ* and *stigmata* are the only essential

Plate LIV

Plate LV.

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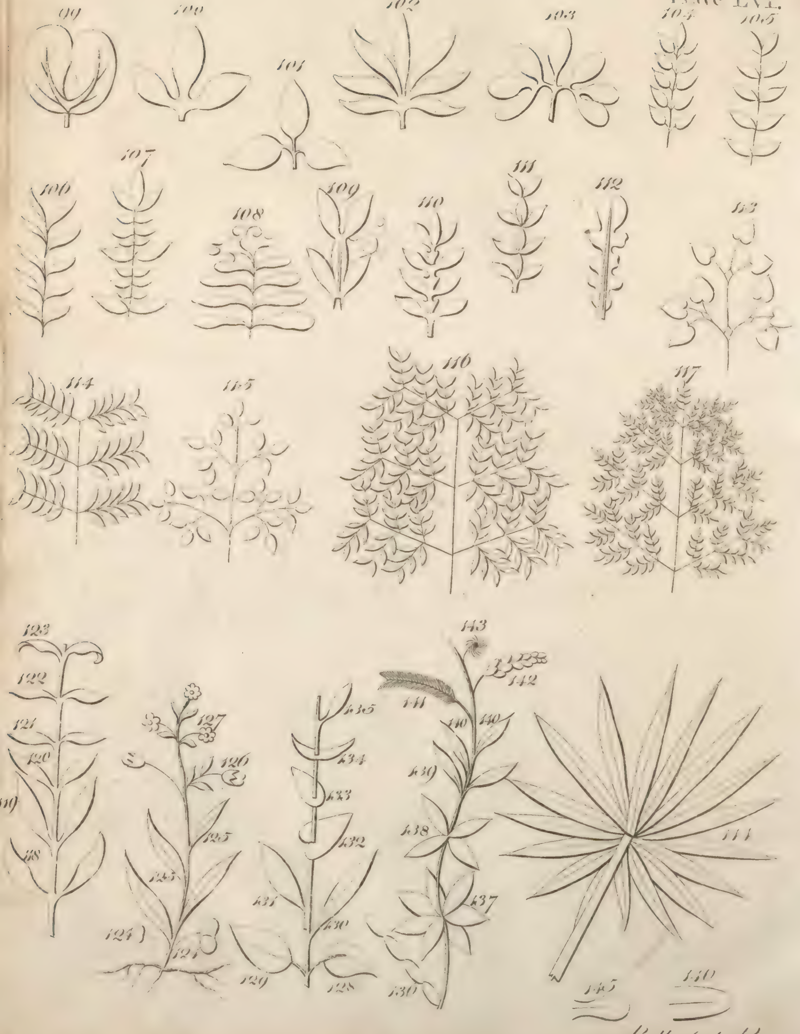
Plate LVI.



Bell Sculp

Plate LVIII.

Plate LVII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Bell Sculp

tial parts of flowers, these parts must necessarily be the *organs of generation*."

Being thus far advanced, Linnæus affirms, that the *antheræ* are the *testes*, and that the pollen performs the office of the male *semen*. These affirmations he attempts to establish by the following arguments; the first of which he terms

" 1. *Præcedentia*.—The antheræ, or vegetable testes, always precede the fruit; and as soon as the antheræ come to maturity, which constantly happens before the maturity of the fruit, they continue to throw out their pollen as long as the flower lasts; but decay and fall off whenever the fruit comes to perfection.

" 2. *Situs*.—The antheræ of all plants are uniformly situate in such a manner that the pollen may with the greatest facility fall upon the stigma or female organ.

" 3. *Tempus*. — The antheræ and stigmata always flourish at the same time, whether the flowers be of the hermaphrodite or dioicous kind.

" 4. *Localumenta*.—When the antheræ are dissected, they discover as great a variety of structure as the pericarpia or seed capsules: For some of them have one cell, as the mercury; some two, as the hellebore, *&c*.

" 5. *Castratio*.—If all the antheræ be cut off from an hermaphrodite plant, just before the flowers begin to expand, taking care at the same time that no plant of the same species grows near it, the fruit will either prove entirely abortive, or produce barren seeds.

" 6. *Figura*.—When the pollen of different plants is examined by the microscope, it exhibits as great a variety of figures as is discoverable in the seeds themselves

" The accumulated force of these arguments", concludes Linnæus, " amounts to a full demonstration that the antheræ are the testes, and that the pollen is the semen or genitura of vegetables.

" The male organ being thus investigated, we hope," says Linnæus, " that none will hesitate to pronounce the stigma to be the female organ, especially when the following observations are sufficiently attended to.

" The pistillum is composed of the germen, stylus, and stigma The germen being only a kind of rudiment of the future fœtus or seed, ceases to exist as soon as the flower comes to maturity. Neither is the stylus an essential part, as many flowers have no stylus. But no fruit ever comes to maturity without the assistance of the stigma. It follows, that the stigma must be the female organ adapted by nature for the reception of the pollen or impregnating substance. This will appear still clearer from the following chain of reasoning.

" 1. *Situs*.—The stigmata are always situate so that the pollen may with most ease fall upon them. Besides, it is remarkable, that in most plants (though not in all) the number of the stigmata exactly corresponds with the loculamenta or cells of the pericarpium.

" 2. *Tempus*.—Here the observation, that the stigmata and antheræ constantly flourish at the same time, is repeated.

" 3. *Decidentia*.—The stigmata of most plants, like the antheræ, decay and fall off as soon as they have discharged their proper function; which evidently shows, that their office is not to ripen the fruit, but solely to answer the important purpose of impregnation.

" 4. *Abscissio*.—The argument here is precisely the same with the castration of the antheræ; and the result is likewise the same, namely, the destruction of the fruit.

" These arguments," concludes Linnæus, " are sufficient to demonstrate, that the stigma is the female organ of generation, or that organ which is suited for the reception and conveyance of the semen to the *vegetable eggs*. Hence, plants may be said to be *in actu veneris*, when the antheræ, or testiculi, spread their pollen over the stigma or female *vulva*."

To show how the *coitus* of vegetables is effected, is our author's next object of investigation. He affirms, that the pollen is conveyed, by means of the wind or insects, to the moist stigma, where it remains until it discharges a subtile fluid, which, being absorbed by the vessels of the stigma, is carried to the seeds or ova, and impregnates them. His proofs are taken from the following particulars.

" 1. *Oculus*.—When the flowers are in full blow, and the pollen flying about, every one may then see the pollen adhering to the stigma. This he illustrates by mentioning as examples the viola tricolor, iris, campanula, *&c*.

" 2. *Proportio*. — The stamina and pistilla, in most plants are of equal heights, that the pollen, by the intervention of the wind, may, with the greater facility, fall upon the stigma.

" 3. *Locus*.—The stamina of most plants surround the pistillum, to give the pollen an opportunity of falling on the stigma at every breeze of wind. Even in the monœcia class, the male flowers stand generally above the female ones, to afford an easier conveyance of the pollen to the stigma.

" 4. *Tempus* It is remarkable that the stamina and pistilla constantly appear at the same time, even in plants belonging to the monœcia class.

" 5 *Pluviæ*.—The flowers of most plants expand by the heat of the sun and shut themselves up in the evening or in rainy weather. The final cause of this must be to keep the moisture from the pollen, lest it should be thereby coagulated, and of course prevented from being blown upon the stigma.

" 6. *Palmicolæ*.—That the cultivators of palm trees were in use to pull off the spadices from the males, and suspend them over the spathæ of the females, is attested by Theophrastus, Pliny, Prosper Alpinus, Kempfer, and many others. If this operation happened to be neglected, the dates were sour and destitute of nuts. Kempfer adds this singular circumstance, that the male spadix, after being thoroughly dried and kept till next season, still retained its impregnating virtue.

" 7. *Flores nutantes*.—As the pollen is specifically heavier than air, such flowers as have their pistillum longer than the stamina, hang down, or incline to one side, *e. g.* the fritillaria, campanula, *&c*. An easy admission of the pollen to the stigma, is the final cause of this appearance.

" 8. *Submersi*.—Many plants that grow below water, emerge when their flowers begin to blow, and swim upon

upon the ſurface till they receive their impregnation, and then ſink down.

"9. *Omnium florum genuina conſideratio.*—Here a number of particulars are recited. We ſhall confine ourſelves to thoſe that are moſt ſtriking and applicable to the ſubject.

"When the flowers of the male hemp are pulled off before thoſe of the female are fully expanded, the females do not produce fertile ſeeds. But as a male flower is ſometimes found upon a female plant, this may be the reaſon why fertile ſeeds are ſometimes produced even after this precaution has been obſerved.

"The tulip affords another experiment to the ſame purpoſe.—Cut off all the antheræ of a red tulip before the pollen is emitted; then take the ripe antheræ of a white tulip, and throw the pollen of the white one upon the ſtigma of the red; the ſeeds of the red tulip being thus impregnated by one of a different complexion, will next ſeaſon produce ſome red, ſome white, but moſt variegated flowers."

In the year 1744, Linnæus publiſhed a deſcription of a new genus, which he called *peloria*, on the ſuppoſition of its being a *hybrid* or *mule* plant, *i. e.* a plant produced by an unnatural commixture of two different genera. The root, leaves, caulis, *&c.* of this plant are exceedingly ſimilar to thoſe of the antirrhinum linaria; but the flower and other parts of fructification are totally different. On account of its ſimilarity to the linaria in every part but the flower, Linnæus imagined it to have been produced by a fortuitous commixture of the linaria with ſome other plant, although he has never yet been able to condeſcend on the father. This doctrine of the production of *mule* plants has ſince been greatly prized and carefully propagated by Linnæus and the other ſupporters of the ſexual hypotheſis. In the third volume of the *Amœnitates Academicæ*, there is a complete diſſertation, intitled, *Plantæ Hybridæ*, wherein the doctrine of *vegetable mules* is much improved and extended. This diſſertation contains a liſt of 47 mules, with their ſuppoſed fathers and mothers. For example,

The Veronica Spuria is ſaid to be a *mule* plant *begot by* the verbena officinalis *upon* the veronica maritima.

The delphinium hybridum, a *mule begot* by the aconitum napellus *upon* the delphinium elatum.

The arctotis calendula, a *mule begot* by the calendula pluvialis *upon* the arctotis triſtis.

The aſclepias nigra, a *mule begot* by the cynanchum acutum *upon* the aſclepias vincetoxicum, *&c.*

From the examples given in this diſſertation, Linnæus draws this ſingular concluſion, that only two ſpecies of each genus exiſted *ab origine*; and that all the variety of ſpecies which now appear have been produced by unnatural embraces betwixt ſpecies of different genera.

Under this head, Linnæus likewiſe quotes from Ray the ſtory of Richard Baal gardener at Brentford. This Baal ſold a large quantity of the ſeeds of the braſſica florida to ſeveral gardeners in the ſuburbs of London. Theſe gardeners, after ſowing their ſeeds in the uſual manner, were ſurpriſed to find them turn out to be plants of a different ſpecies from that which Baal made them believe they had purchaſed; for, inſtead of the braſſica florida, the plants turned out to be the braſſica longifolia. The gardeners, upon making the diſcovery, commenced a proſecution of fraud againſt Baal in Weſtminſter-hall. The court found Baal guilty of fraud, and decerned him not only to reſtore the price of the ſeeds, but likewiſe to pay the gardeners for their loſt time, and the uſe of their ground. "Had theſe judges (ſays Linnæus) been acquainted with the ſexual hypotheſis, they would not have found Baal guilty of any crime, but would have aſcribed the accident to the fortuitous impregnation of the braſſica florida by the pollen of the braſſica longifolia."

Linnæus next proceeds to celebrate the utility of inſects, becauſe they convey the pollen of the male to the ſtigma of the female. "In this way," ſays he, "it is reaſonable to think that many dioicous plants are impregnated. Nay, even the hermaphrodites themſelves are greatly obliged to the different tribes of inſects, which, by fluttering and treading in the corolla, are conſtantly ſcattering the pollen about the ſtigma.

"Upon the whole," then, concludes Linnæus, "the coitus of vegetables is evident to a demonſtration. This coitus is nothing more than the conveyance of the pollen to the ſtigma, to which it adheres till it burſts and diſcharges a ſubtile elaſtic fluid. This fluid or aura is abſorbed by the veſſels of the ſtylus, and carried directly to the ovarium or germen, where the myſterious work of impregnation is fully compleated."

These are the arguments employed by Linnæus and other advocates for the ſexual commerce of vegetables.—Let us next attend to thoſe employed by the oppoſers of this hypotheſis.

It is admitted by Pontedera, Dr Alſton, *&c.* that ſome of the acients applied the terms *male* and *female* to ſeveral plants. But then they deny that theſe terms conveyed the ſame ideas to the ancients that they do to the moderns. *Male* and *female*, when applied to plants, were to the ancients mere terms of diſtinction, ſerving only as trivial names to diſtinguiſh one ſpecies or variety from another. The ancients were ignorant of the very characters which conſtitute the difference between what is called a male and female plant among the moderns. Theophraſtus, Dioſcorides, Pliny, and, in a word, the whole ancient bontanical writers, confound the very notion of the modern ſexes; they call the real female, or ſeed-bearing plant, the *male*; and the male, or barren plant, the *female*. Nay, they have even applied the terms *male* and *female* to many plants which bear nothing but hermaphrodite flowers.

Such is the nature of this controverſy, that it cannot be determined with any degree of certainty, but by experiments made upon dioicous plants. If a female plant can produce fertile ſeeds without having any communication with the pollen of the male, the uſe of this pollen, with reſpect to the impregnation of ſeeds, muſt of neceſſity be entirely ſuperſeded.

Now, both Camerarius and Dr Alſton tried theſe experiments with the ſame ſucceſs. Thoſe two eminent botaniſts took female plants of the mercury, ſpinage, and hemp,

hemp, tranfplanted them at a great diftance from any males of the fame genus, and befides had them inclofed by double rows of hedges. The refult was, that each of thefe plants produced great quantities of fertile feeds. Tournefort made the fame trial upon the lupulus, Miller upon the bryony, and Geoffroy upon the mays; and all of them declare that the feeds of thefe plants were as fertile as if they had been furrounded by a thoufand males.

Linnæus, in his firft argument for the coitus of plants, refers every man to the evidences of his fenfes.

"Do we not fee, (fays he) the ftigma of almoft every hermaphrodite flower covered over with the pollen or impregnating fubftance? Do not we fee the parietaria, the urtica, *&c.* by violent explofions, difcharging their pollen in the open air, that it may be carried in that vehicle to the ftigmata of their refpective females?"—All this is admitted by the oppofers of the fexes; but then they deny that thefe explofions, *&c.* are intended to create any intercourfe between the male and the female; and further alledge, that this ejection of the pollen is intended by nature to throw off fomething excrementitious, or at leaft fomething, which, if retained, would prove noxius to the fructification.

Linnæus takes his fecond argument from the proportion which the ftamina bear to the ftylus, alledging that they are generally of the fame height.—This obfervation is not only contrary to experience, but, allowing it to be univerfal, no conclufion can be drawn from it either for or againft the fexual hypothefis.

The third argument is taken from the *locus* or fituation of the ftamina with refpect to the ftylus; "and as the male flowers in the monoecia clafs ftand always above the female flowers, it muft be concluded (fays Linnæus) that the intention of nature, in this difpofition of the parts, is to allow a free and eafy accefs of the pollen to the ftigma."—But the ftamina cannot be faid to furround the piftillum in the monandria and diandria claffes: And the pofition of the male flowers in the monoecia clafs is a mere chimera; for in the ricinus, one of the examples which Linnæus mentions in confirmation of his doctrine, the female flowers ftand uniformly fome inches above the males.

That the ftamina and piftilla generally come to perfection at the fame time, and that this happens even in the dioicous plants, is Linnæus's fourth argument. But, as it is acknowledged by Linnæus himfelf, that there are many exceptions with refpect to this fact, the oppofers of the fexual hypothefis alledge that it carries the beft anfwer in its own bofom.

The fifth argument is founded on the circumftance of fome flowers fhutting up their petals in rainy or moift evenings.—But many flowers do not fhut themfelves up, either in the night or moift weather, as the paffion-flower, *&c.* The lychnis noctiflora, mirabilis peruvianæ, *&c.* open their flowers in the night, and fhut them at the approach of the fun. Hence this is another final caufe evidently perverted to fupport a favourite hypothefis.

We come now to the culture of the palm-tree, which is the fixth and moft plaufible argument employed by the fexualifts. Herodotus, Theophraftus, Pliny, and fome others, have informed us, that the female palm-tree, unlefs a male grows fufficiently near it, or unlefs the pollen be artificially conveyed to the female fpatha, will produce nothing but four dates and unfertile feeds. This fact is partly denied by Pere-Labat and Tournefort. The former of thefe authors exprefsly affirms, that a female palm-tree, in the garden belonging to the monaftery at Martinico, produced moft excellent fruit, although there was not a male within fix miles of it: From which he concludes, that the prefence of the male is not neceffary to render this tree fruitful, whatever may be pretended by ancient or modern naturalifts. Herodotus relates, that the people of Babylon, when the male was at too great a diftance from the female, made a rope pafs from the boughs of the one to the boughs of the other, to afford an opportunity to the culices and other infects to pafs along the rope, and convey fome kind of impregnating influence from the male to the female. Tournefort, when he was in that country, inquired at the moft intelligent people of the place, as to the truth of this relation; but received for anfwer, That they had never heard of any fuch matter. Even the favourers of the fexual hypothefis give very different accounts of the method of cultivating palm-trees in thofe countries. Veflingius, who refided many years in Egypt, denies that any artificial method is employed for fructifying the palm-trees in that country. Thus Veflingius exprefsly contradicts Herodotus and many others. In a word, almoft every different author gives a different account of this ftory. Amidft fo many contradictions concerning the culture of palm-trees, the oppofers of the fexes conclude, that the whole ftory is a vular error, taken for granted by fome learned men, fpurioufly fathered upon others, and fwallowed down without examination by their credulous readers.—As we have not feen any anfwer to Mylefius's letter on this fubject, our obfervations upon it fhall be referved till this hiftorical view of the controverfy be finifhed.

The feventh argument of Linnæus is taken from the *flores nutantes*.—The piftils of thefe flowers, according to Linnæus, are always longer than the ftamina, and nature has affigned them this penfile pofture, that the pollen, which is fpecifically heavier than air, may the more conveniently fall upon the ftigma.—But the piftils of the campanula, lilium, and many other *flores nutantes*, are not longer than the ftamina. Befides, granting this were uniformly the cafe; yet, as the pollen is heavier than air, this pofture muft of neceffity either make the pollen mifs the piftillum altogether, or, at any rate, it can only fall upon the back part of the piftil in place of the ftigma; and, of courfe, fuch a direction would rather tend to fruftrate than promote the impregnation of the feed.

The eighth argument is taken from the *plantæ fubmerfæ*, which are faid to emerge as foon as their flowers begin to blow, left the pollen fhould be coagulated or wafhed off by the water.—But many fubmarine and aquatic plants fructify entirely below water; and, fuppofing they did not, the fame argument would equally prove it to be the intention of nature, that the pollen fhould be blown away by the winds, as that it fhould be fubfervient to the impregnation of the feed.

The

The ninth and laſt argument is intitled *Omnium florum genuina conſideratio*; which is nothing more than a collection of vague obſervations upon the ſtructure and œconomy of particular plants, ſome of them true, others falſe, but all of them evidently thruſt in as ſupports to a favourite hypotheſis.

Having thus given a pretty full hiſtorical view of the controverſy concerning the ſexes of plants, we ſhall now lay before our readers a few obſervations that have occurred from the peruſal of it.

It may be obſerved in general, that the facts and arguments adduced by the ſexualiſts are by far too few to admit of any general induction. Nay, moſt of them are merely accidental, many of them not being uniform even in the ſame ſpecies; and the final cauſes of the whole are unnatural, and tortured ſo as beſt to anſwer the purpoſes of a theory, which, for all that hath yet been ſaid, merits no higher appellation than that of a whimſical conjecture.

Firſt, then, Linnæus's reaſoning is of a mixt nature, partly analogical, partly founded on obſervation. He ſets out with an attempt to prove, that plants are endowed with a certain degree of animal life; and his fundamental reaſon is, becauſe, agreeable to Dr Harvey's definition of life, they *ſpontaneouſly propel humours*.—Strange, that a man of Linnæus's capacity, or indeed of any capacity at all, ſhould ſeriouſly employ an argument pregnant with every degree of abſurdity!—Stranger ſtill that he ſhould take up near twenty pages in illuſtrating and drawing concluſions from ſuch an argument!—If Harvey has given a vague and unintelligible definition of life, can that be a ſufficient excuſe for laying hold of ſuch a definition in order to fortify an unſtable hypotheſis? But, were Harvey's definition more accurate than it is, and were vegetables actually poſſeſſed of living powers, it is eaſy to conceive how the life of vegetables might be a proper teſt of, or contradiction to, the received definition: But, how a definition, which, from the complex and intricate nature of the ſubject defined, muſt neceſſarily be vague and precarious, can be employed in confirmation of any general theory, exceeds the powers of common apprehenſion.

But let us examine this notable definition a little further: What idea of life does a *ſpontaneous propulſion of humours* convey? If Harvey means to ſay, that men and other animals regulate the motion of their blood, and the ſecretions of their different humours, by certain exertions of the ſentient principle, ſuch a meaning is contradicted by univerſal experience; ſo far is this from being the caſe, that the moſt abſtract attention cannot render us conſcious of theſe motions. Again, if he means, that every body is endowed with life, whoſe organs are ſuited to propel humours, then the term *ſpontaneous* is abſurd, becauſe it aſcribes intellectual powers to the organs themſelves, than which nothing can be more ridiculous. Beſides, allowing the organs to enjoy an independent faculty of propulſion, what does this propulſion mean when applied to vegetables? Surely nothing more than a power of conveying certain liquors from the root to the ſuperior parts of the plant. A wet cloth, with one end in contact with the water in any veſſel, and the other hanging over its ſide, will do the ſame; ſo will a ſpunge, ſo will a bed of looſe ſand, ſo will a ſugar loaf, *&c.*; but it is to be hoped, that mankind have more ſenſe than to believe that a bit of cloth, or a ſugar loaf, are animated beings.

As conſcious of the lameneſs and futility of his reaſoning on this ſubject, Linnæus endeavours further to corroborate the life of vegetables by analogies drawn from their nutrition, age, motions, diſeaſes, death, anatomy, and organization. In theſe nothing new or remarkable occurs, excepting the uncommon method of reaſoning, and the ſtill more whimſical purpoſes to which this reaſoning is applied. We ſhall take notice of his arguments under the articles of *motion* and *death*, which indeed are the chief of thoſe which do not depend more or leſs upon the above definition.

Under the former of theſe, Linnæus informs us, that plants, when confined within doors, always bend towards the light; and that many flowers, particularly thoſe of the ſyngeneſia claſs, purſue the courſe of the ſun from eaſt to weſt. This inclination of flowers towards the light, Linnæus would have us to believe are real inſtances of the living powers and ſpontaneous motion of plants.—This phenomenon, however, may be eaſily accounted for, independent of any idea of life. Every body knows, that a certain degree of heat relaxes the tone of the vegetable organs, and at the ſame time proportionally evaporates the fluids which theſe organs contain. Now, to whatever ſide of the plant that heat is principally applied, there of neceſſity muſt alſo be the greateſt flaccidity of the fibres, and the greateſt evaporation of the fluids; of courſe, from the law of gravitation, the flower, indeed the whole plant, muſt incline towards that ſide from whence the light or heat proceeds. The ſlighteſt obſervation is ſufficient to convince us of the propriety of this method of accounting for the inclination of heavy flowers ſupported by weak ſtems, towards the rays of the ſun. If a pot of flowers be put looſely into a glaſs, and allowed to remain a little time in an apartment where a fire is burning, as ſoon as the fibres begin to be enervated, they all, unleſs obſtructed by ſome other cauſe, bend towards the fire. Hence the abſurdity of aſcribing this phenomenon to a ſentient and living principle, which is more eaſily and with more certainty explained by the common laws of mechaniſm.

Let us next attend to Linnæus's argument under the article of *death*. After telling us, with much ſolemnity, that death is only a privation of life, and that vegetables *die* of many grievous diſtempers, he thus concludes; "With what propriety," ſays he, "could vegetables be thus ſaid to *die*, unleſs it be allowed that they previouſly *lived*?" However, if the life of vegetables hath no other ſupport than this trifling quibble, (for it merits not the name of argument), we are afraid that every man of common ſenſe will conclude, that they never were endowed with *life*, and conſequently cannot, with any more propriety than an ordinary figure of ſpeech can beſtow, be ſaid to *die*.

Having in this manner attributed living powers to vegetables, Linnæus, in the next place, makes an effort to ſhow

ſhow, that they enjoy the faculty of generation. But what proceſs of argumentation does he employ? He lays hold of another maxim of Dr Harvey: *Omne vivum ex ovo*, ſays Harvey. "Now," adds Linnæus, "we have already proved that vegetables *live*; and therefore they muſt in like manner derive their origin from eggs. Again, no eggs can be fertilized without receiving an impregnation from the ſemen of the male: And hence the eggs or ſeeds of vegetables muſt likewiſe be impregnated by the male vegetable ſemen, in order to their fertilization. Further, it is an eſſential property of an egg to produce a creature of the ſame ſpecies with that from which itſelf was produced: Hence the ſeeds are the eggs of vegetables. Beſides, as the antheræ and ſtigmata are the only eſſential parts of a flower, it follows, that theſe parts are the organs of generation." In this way Linnæus goes on till he finds the antheræ to be the teſtes; the pollen, the ſemen; and the ſtigma, the female organ of generation.

But, as we have already ſhewn that Linnæus has remarkably failed in the proof of his firſt point, namely, that vegetables are endowed with life, his ſubſequent reaſoning, which reſts ſolely on the ſuppoſition of the living powers of vegetables, muſt of courſe fall to the ground.

However, allowing a *ſpontaneous propulſion of humours* to be a perfect definition of life, philologiſts are far from being agreed with regard to the propriety of Harvey's ſecond maxim. *Omne vivum ex ovo* may be be applied to a great variety of animals. But to this day it remains a very doubtful point, whether man and moſt quadrupedes derive their exiſtence from the ſame ſource. Hence the impropriety of drawing an analogy from a property not univerſal even among the animal creation in order to ſupport an imaginary one among the vegetable tribes.

When our author comes to explain the manner in which the *coitus* of vegetables is performed, he tells us, that the pollen may be ſeen lying upon the top of the ſtigma in moſt hermaphrodite flowers, where it is diſſolved by the moiſture which conſtantly adheres to that part; and after this diſſolution, that the *ſeminal aura* contained in the pollen is abſorbed by the ſtigma, and ſo conveyed directly to the ſeeds.

This account of the coitus lies open to two objections. 1ſt, Admitting that the pollen may be ſeen adhering to the ſtigmata of moſt hermaphrodite plants, and admitting likewiſe that moiſture cauſes the pollen to burſt and diſcharge a *ſubtile fluid*, ſtill a very natural queſtion occurs with regard to the abſorbing quality of the ſtigma. It is true, that the top of the ſtigma is generally covered with moiſture. But does not this indicate that the proper office of the ſtigma is to ſecern and propel rather than to abſorb moiſture? It will be the more readily admitted, that the veſſels of the ſtigma are not ſuited to abſorb, if it be conſidered that the moiſture of the ſtigma is ſubjected to a conſtant evaporation, and of courſe muſt always ſtand in need of new ſupplies of this liquor, which can flow from no other ſource than the internal veſſels of the ſtigma itſelf. It may indeed be alledged, that the ſtigma is furniſhed with two ſets of veſſels, one for abſorbing the ſeminal fluid, another for ſecerning the diſſolving moiſture. No body, however, has ever pretended to ſhow that the ſtigma is poſſeſſed of any peculiar veſſels for abſorbing; whereas every man's eyes will convince him that it is poſſeſſed of ſecerning veſſels: Hence, until the abſorbing quality of the ſtigma be ſufficiently proved, the poſſibility of an impregnation in this way muſt at leaſt remain problematical.

2dly, Linnæus makes the appearance of the pollen adhering to the ſtigmata of hermaphrodite flowers an ocular demonſtration of an actual coitus. Granting this to be an ocular demonſtration of the *coitus* of vegetables, ſhould not the pollen be likewiſe ſeen adhering to the ſtigmata of dioicous plants? But the appearance of pollen upon the ſtigmata of dioicous plants has never yet been diſcovered. We may, therefore, fairly conclude, that if the appearance of pollen upon the ſtigmata of hermaphrodite flowers be an ocular demonſtration of the coitus or copulation of plants, the want of that appearance, or no pollen's being ever ſeen upon the ſtigmata of dioicous flowers, muſt likewiſe be an ocular demonſtration of the contrary!

In ſupporting theoretical opinions, mankind are extremely apt to render the ſubject ridiculous by puſhing them too far. No man ever blundered more remarkably in this reſpect than Linnæus. He is not ſatisfied with attributing life and a generative faculty to plants: He muſt likewiſe attempt to prove, that this generative faculty is ſo ſtrong and vigorous, as to enable them to produce hybrids or *mules*, by means of unnatural commixtures.

In ſupport of this notion, he tells us, that, when the antheræ of a red tulip are cut off, and the ripe antheræ of a white one are ſhaked over the ſtigma of the red one, the ſeeds of the red tulip, by this artificial impregnation, will produce flowers ſtreaked with red and white. Of this fact no body who knows any thing of the nature of tulips, and the changes to which the colour of their flowers are liable, will entertain any doubt. But this change of colour is evidently aſcribed to a wrong cauſe; for the ſame change would unqueſtionably happen whether the antheræ of the white tulip had been ſhaked over the ſtigma of the red one or not. When tulips blow for the firſt time, their petals are generally of one uniform colour. For ſeveral ſucceeding ſeaſons this original colour continues to vary, in ſo much that, by certain methods of culture, the colour of the flower may be varied without end. Linnæus, in his ſyſtematic works, wiſely cautions his readers not to found any diſtinctions upon the colour of plants, which, he obſerves, is ſubject to ſuch numberleſs alterations from culture, ſoil, and other caſual incidents, that it can never furniſh the botaniſt with any permanent or uniform marks. With what propriety, then, Linnæus attributes the change in the colour of this tulip to his artificial impregnation, is ſubmitted to the conſideration of his warmeſt admirers.

The firſt hint of mules was taken from a plant the figure and diſpoſition of whoſe leaves, &c. reſembled the antirrhinum linaria, or common yellow toad-flax; but attended with this peculiarity, that its parts of fructification were entirely diſſimilar. Linnæus, when the plant was firſt preſented to him, imagined it to be ſome kind of

of deception. But, after a more accurate examination, the notion of a *ſpurious* iſſue opportunely came to his aid. The thought pleaſed him on a double account: It had a direct tendency to corroborate his favourite hypotheſis, and laid the foundation of another ſtill more extravagant. Now, thinks he, by this ineſtimable diſcovery, we ſhall be enabled to take a dry and rigid plant from the mountain's top, make it copulate with a moiſt and ſpungy aquatic, and their offspring will participate of the rigidity and hardneſs of the former, together with the moiſture and flaccidity of the latter; and hence mankind ſhall ſoon be bleſſed with an eaſy purchaſe of their united virtues when flouriſhing in the intermediate vale! More wonderful ſtill, we ſhall cauſe the plants which dwell upon the frozen mountains of Greenland to *intermarry* with the more delicate and wayward inhabitants of the torrid zone, and the conſtitutions of their children ſhall be ſo moulded and attempered, that they will live moſt comfortably in every temperate clime!—Not contented with extracting two theories out of this ſingle plant, Linnæus forms a third ſtill more wild and fantaſtical: "From this curious phænomenon," ſays he, "it is natural to think, that only two ſpecies of each genus exiſted *ab origine*, and that all the variety of ſpecies which now appear are only the ſpan of fortuitous commixtures!"

If either the fortuitous or artificial copulation of two different ſpecies were capable of producing a third perfectly diſtinct from the other two, the number of ſpecies would be infinite. According to our author, every blaſt of wind, every butterfly, would daily produce hundreds of new ſpecies. Neither the gardener nor huſbandman could purchaſe ſeeds with ſafety, unleſs they could diſcover, from inſpection, whether they had been impregnated by the ſemen of the ſame, or of a different ſpecies. Linnæus would have us to believe, not only that different ſpecies of the ſame genus copulate together, but even that genera belonging to different claſſes engender, and beget mules. For example, he makes the poterium hybridum a mule, *begot by* the agrimonia eupatoria *upon* the poterium ſanguiſorba. The agrimonia belongs to the dodecandria digynia claſs, and the poterium to the monœcia polyandria. Now, let any man ſeriouſly conſider the unavoidable conſequences that would follow on the ſuppoſition that this wanton proſtitution of ſexes really exiſted among vegetables In the firſt place, it would be impoſſible to reduce botany to any regular ſyſtem; for every ſeaſon would produce ſuch a troop of new and ſtrange plants, as would confound every ſcheme or method of claſſification that ever was, or ever will be invented. A botaniſt, for inſtance, carefully collects and preſerves the ſeeds of the poterium, in order to raiſe that plant next ſeaſon; but, after ſowing the ſeeds, to his utter aſtoniſhment, not a ſingle poterium appears, but every one of them is metamorphoſed into a ſpecies of agrimonia, a plant ſo totally different that it cannot even be arranged under the ſame claſs. 2dly, Linnæus is obliged to confeſs, that his *vegetable mules*, are not ſubjected to that perverſe law of nature, which cruelly prevents animal mules from propagating their ſpecies. On the contrary, his vegetable mules enjoy all the ſweets of mutual embraces, and all the comforts that ariſe from a numerou progeny! It is a happy circumſtance that the œconomy of nature is not influenced by the whims and caprices of thoſe very ingenious and learned gentlemen whoſe heads are conſtantly hunting after hypothetical phantoms. There is hardly a general theory of the œconomy of animals, or vegetables, which, on the ſuppoſition of its truth, would not in a very ſhort time extirpate both animals and vegetables from the face of the earth. In the theory under conſideration, we have not only mules produced by different genera and ſpecies, but theſe very mules ſucceſsfully propagating their kinds, and ſubject to be metamorphoſed *ad infinitum* by ſubſequent impregnations. This would be ſtrange work indeed! How unlike the œconomy of nature!—Let us take an example, and trace it through a few metamorphoſes. A nettle receives an impregnation from an oak, the ſeed falls to the ground, a plant of a very uncouth aſpect ſprings up; it is no longer a nettle, neither is it an oak; but then it makes an excellent *mule!* This mule next receives an impregnation from a turnip; the ſeed now brings forth neither a nettle, an oak, nor a common mule, but ſomething ſo monſtruous that no language can afford a name for it! Theſe are a few of the conſequences that would inevitably happen, if this theory of ſexual embraces were really founded in nature.

It is natural to think, that no author would venture to publiſh a theory of this kind, without having previouſly made a great variety of ſucceſsful experiments. If plants were really capable of unnatural commixtures, any perſon might make many hundred mules in the ſpace of twelve months. But we can affirm with confidence, that Linnæus never made a ſingle *vegetable mule* in his life. He has indeed collected forty-ſeven plants which he calls mules. Why? not becauſe they were produced by an artificial or fortuitous impregnation; but becauſe the leaves, ſtem, or parts of fructification have a reſemblance to ſome other genus or ſpecies; even of theſe forty-ſeven he acknowledges that thirteen cannot be depended upon. The only attempts he has made to produce mules, have been confined to a few hermaphrodite plants: When endeavouring to *impregnate* a plant, Linnæus proceeds in this manner: He lays hold of a hermaphrodite plant juſt before the flowers begin to blow; unfolds the petals, cuts off all the ſtamina, and then with his own hands performs the office of a male plant, by ſhaking the pollen of a different ſpecies over its piſtillum. This operation being finiſhed, he ſows the ſeeds next ſeaſon:—Now, if Linnæus's theory were juſt, theſe ſeeds ſhould produce mules, or plants which cannot be referred to any of the two ſpecies upon which the experiment was made. But all the changes he has ever been able to produce by his manual impregnations are confined to the colour of the flower; a different ſtreak or ſhade in the petals paſſes with him for a mule or mixture of the ſpecies, although, in other parts of his works, he poſitively declares, that generic or ſpecific differences can never be taken from the colour of flowers, as it is conſtantly liable to a thouſand changes from cauſes that are merely fortuitous.

But no experiment can be made with any degree of candor upon hermaphrodite flowers. No man can determine with

with certainty what changes the young feeds may undergo, what injury they may fuffer, by prematurely forcing open their petals and cutting off the ftamina. If a pregnant animal be wounded, and in a part too intimately connected with the fœtus, what reafon have we to hope for a beautiful or well-proportioned offspring? One thing however is certain, that if the office of the ftamina, as is alledged by the oppofers of the fexes, be to feparate and carry off noxious or excrementitious matter from the fruit, the retention of this matter would of itfelf introduce a change into the colour of the future plant; becaufe in that cafe the feeds would not be properly purged or rectified, being prematurely deprived of the veffels deftined for that purpofe.

We fhall now examine the famous ftory of Baal the gardner at Brentford, related above in the hiftorical view of the controverfy. Linnæus accufes Baal's judges of ignorance, becaufe they convicted him of fraud. But, would not any judge fmile to hear himfelf branded with ignorance, or a partial adminiftration of juftice, merely becaufe he paid no regard to the fexual commerce of plants in his decifions? It is happy for mankind that judges are obliged to decide according to law or equity, and not according to the hypothetical whims of the naturalift.—But, even fuppofing Baal's judges to have had a perfect knowledge of the fexual commerce of vegetables, and to have been at full liberty to determine the point of law upon that medium, if they had acquitted Baal of fraud, or at leaft of negligence, we fhould have been inclined to doubt both of their integrity and ingenuity.—It is acknowledged, that great quantities both of the braffica florida and braffica longifolia were raifed that feafon in Baal's garden. A feedfman or gardner, in packing up many parcels of different feeds, by the fimple error of putting a wrong mark upon any of the parcels, would produce a miftake fimilar to this of Baal's. But, whether the circumftance took its rife from negligence or fraud, belongs not to our prefent inquiry. Even upon Linnæus's own principles, it is far from being clear of abfurdity, how, by a cafual impregnation, the fpecies of a plant could be entirely changed. For, by the analogy of all animals, nay, taking our analogy from Linnæus's vegetable mules, this fortuitous impregnation fhould have only produced a mule, or mixture of the two fpecies, and not a perfect metamorphofis of either. Hence it may be fairly concluded, that this famous ftory, upon which the fexualifts lay fo much ftrefs, inftead of ftrengthening, tends to the final deftruction of that hypothefis in fupport of which it was originally adduced.

Of a fimilar nature is the ftory contained in Mylius's letter to Dr Watfon. This gentleman writes to his correfpondent, "that a female palm tree grew many years in the garden belonging to the Royal Academy at Berlin, without producing any ripe or fertile fruit; that a male branch, with its flowers in full blow, was brought from Leipfic, which is about twenty German miles from Berlin, and fufpended over the female; the refult of this operation was, that the female, that very year, produced 100 ripe and fertile fruit. The fame experiment being repeated the following year, 2000 ripe fruit were produced."—Not to call Mylius's veracity in queftion, we fhall allow the fact to be as he has related it: Neverthelefs it is far from being fatisfactory. Berlin is not the native climate of palm-trees. Mylius informs us, that this palm bore flowers and fruit for thirty years before the experiment was tried; but the fruit never came to full maturity. Now it is well known, that many exotic plants, particularly thofe of the larger kinds, feldom produce ripe fruit in a climate which is not adapted by nature for their nourifhment, unlefs they are affifted by artificial culture, and have grown in that climate for a great number of years. Mylius's palm-tree had carried unripe fruit for the fpace of thirty years. Now, according to the ufual courfe of exotics, it is natural to think that, during all this time, the fruit was every feafon making gradual advances towards perfection: It might fo fall out, then, that at the very feafon when the male branch was fufpended over the female, the plant had arrived at the higheft degree of perfection it could ever acquire in the climate of Berlin; and of courfe, the accidental circumftance of fufpending the male branch over it, at this critical period, might give rife to the deception of attributing the perfection and fertilization of the fruit to the prefence of the male branch. The circumftance of the tree's bringing forth only 100 ripe fruit the firft year, and 2000 the fecond, remarkably favours this account of the matter.

However, be this as it will, the experiment is fo very defective, that no conclufion can be drawn from it either for or againft the fexual hypothefis. To convince any thinking perfon, that the fertility of this tree was folely owing to fome impregnating virtue derived to it from the male branch, a branch fhould have been fufpended over the female one year, omitted the next, and fo on alternately for a courfe of years, or (as Linnæus would exprefs it), giving her a hufband one year, and depriving her of that gratification the next. After treating the female in this manner for feveral years, if it had uniformly happened, that the fruit was fertile every year the male branch was fufpended over it, and unfertile every year that the fufpenfion of the male branch was omitted, then indeed there would have been a foundation for concluding, that there was fome connection between the fertility of the fruit and the prefence of the male branch. But as this neceffary ftep has been neglected, the experiment is incomplete, and the conclufion drawn from it uncandid and precipitate.

We cannot conclude our remarks on this theory, without hazarding a few obfervations on the truly miraculous effects which Linnæus afcribes to the wind. In accounting for the impregnation of all the dioicous and moft of the hermaphrodite plants, recourfe is conftantly had to the wind, which is faid to convey the pollen of the male to the ftigmata of the female. When the female again is at fuch a diftance as to render the carriage of the pollen fufpicious or impoffible, our author is not difcouraged by this circumftance, but confidently affirms, that fome infect has been rummaging amongft the ftamina of the male, carries off a quantity of the pollen adhering to its legs, and, unconfcious of its precious load, flies from flower to flower till it arrives at the *unmarried* female, where

where ſtopping to take another bait, it luckily depoſites ſome of this adhering pollen directly upon the ſtigma of the female !—

Here it is proper to obſerve, that generation is one of the capital, and indeed one of the moſt important laws of nature that we are acquainted with. The laws of nature are all fixed, ſteady, and uniform in their operation. None of the effects produced by them are ſubject to thoſe uncertainties which always reſult from chance or any fortuitous train of circumſtances. But is there any thing in nature more unſettled, deſultory, and capricious, than the direction and motions of the wind? Can we form a conception of any thing more caſual and fortuitous than the wild and wayward paths of inſects? The very ſuppoſition, therefore, that nature has left the generation of at leaſt a tenth part of the whole vegetable tribes to theſe accidental cauſes, muſt be unphiloſophical, whimſical, and abſurd. We will be the more readily convinced of the abſurdity of this doctrine, when it is conſidered that many of the monœcious and dioicous plants are of the utmoſt importance to the human race, and the conſequent impropriety that the fructification of theſe ſhould be ſubject to the ſport of the winds.

After all, it requires the utmoſt ſtretch of fancy to conceive the poſſibility of a regular impregnation by means of the wind, even when the male and female are within 500 yards of each other, which is a much more favourable ſuppoſition than two, three, or according to ſome authors, a dozen of miles. Conceive then a male and female hemp, or any other dioicous plant, growing 500 yards aſunder. Let the male and female flowers, which, by the by, is not always the caſe, blow at the ſame time. Well, the antheræ are fully ripe; the pollen is diſcharged; and the ſtigma, as our author expreſſes it, *gaping wide* for its reception. Now, even this favourable ſuppoſition is ſubject to ſo many accidents, and pregnant with ſuch a troop of improbabilities, that it is abſolutely impoſſible, upon any principles of belief hitherto invented, to be fully perſuaded that the pollen, in ſuch circumſtances, can be thus conveyed on the wings of the wind, directly to the ſtigma, a point in moſt plants juſt not inviſible.—To accompliſh a regular impregnation in this way, whenever the antheræ are ripe, the wind muſt blow in a direct line from the male to the female; if the blaſt be too ſtrong, it will overſhoot the mark; if too weak, it will fall ſhort of it; if any vegetable or other body higher than the plants themſelves intervene, the progreſs of the pollen will be intercepted;—if it rains, the pollen will be beat to the ground;—the leaſt tremor of the air, or ſmaller blaſt reflected from any other quarter, will infallibly alter the direction of this fluctuating pollen.——Nay, ſuppoſing Linnæus, or any other expert botaniſt, ſhould take his ſtation by the male plant, having his pockets loaded with pollen; ſuppoſe him further to take every advantage of wind and weather, and aiming at the female, let him, for hours together, throw at her repeated handfuls of this fructifying pollen, it is a thouſand to one, if, at the diſtance of 500 yards, a ſingle grain of pollen would touch any part of the female, and many millions to one againſt its falling directly upon the ſtigmata of her reſpective flowers. In a word, this theory of impregnation by the wind, is a palpable refuge of ignorance, invented with a view to account for the fructification of dioicous plants, which Linnæus knew to be a formidable barrier ſtanding in oppoſition to the ſexual hypotheſis. How far that obſtacle is removed by this vague ſubterfuge, is ſubmitted to the judgment of every candid inquirer.

Upon the whole, we have endeavoured to ſhow, that every fact or experiment Linnæus has employed to ſupport his theory of the procreation of vegetables by means of ſexual embraces, is either falſe, or accidental; and that the concluſions drawn from them are unnatural, and often ſtrained to ſuch a pitch of extravagance as renders them truly ridiculous.

The only argument that now remains to be examined, is drawn from the analogy betwixt animals and vegetables. That many beautiful analogies may be traced betwixt the animal and vegetable, is an undeniable truth. But, in reaſoning upon a phyſical ſubject, which admits of a clear determination by experiment, to truſt ſolely or chiefly to analogical deductions, is an evident mark either of a bad reaſoner or an unſtable hypotheſis. The very nature of analogy preſuppoſeth ſome radical difference in the ſubjects between which the reſemblance ſubſiſts. If the analogy be ſupported by facts and experiments, they mutually ſtrengthen the evidence But, if the analogy be not ſupported by facts and experiments, or, if the experiments contradict the analogy, which is the caſe with the theory under conſideration; in either of theſe inſtances the analogy is carried beyond its proper limits, and affords no argument in favour of the hypotheſis. Without the concurrence of facts, how can we be certain but that the very property we contend for conſtitutes the eſſential difference betwixt the two ſubjects? Without facts, how can we be certain but that generation by the intercourſe of ſexes is the identical characteriſtic by which an animal and vegetable are diſtinguiſhed? Theſe principles are applicable even in the caſe of a perfect and uniform analogy, but acquire an accumulated force when the analogy is partial and incomplete, which is evidently the caſe with regard to the ſexual commerce of vegetables.

For example, to compleat the analogy in dioicous plants, a male ſhould be uniformly found growing by the ſide of the female; and beſides, at the age of puberty, or as ſoon as the antheræ come to maturity, the male flower ſhould be ſituated in ſuch a manner, that the pollen could not poſſibly miſs the ſtigmata of the female flowers, from whatever quarter the wind might blow: the ſame thing ſhould take place with regard to the monoicous flowers. But this is not the analogy preſented to us by nature. On the contrary, the males and females ſeldom grow in the neighbourhood of each other. Nothing is more common than to meet with large beds of males growing in one place, and large beds of females at the diſtance of ſome miles from them, pointing out, as it were, that no neceſſary connection, no mutual affection, no natural dependence ſubſiſted between theſe males and females; but rather that nature intended, for ſome purpoſe or other, that they ſhould be kept at a diſtance.

Further, the ſexualiſts, in ſupport of their theory, are

are obliged to have recourſe to the unpardonable impropriety of employing a double analogy, the one betwixt the animal and vegetable, the other betwixt two different tribes of vegetables. In order to account for the propagation of the muſci, fungi, and, in a word, the whole cryptogamia claſs, whoſe parts of generation are either wanting altogether, or inviſible to our eye-ſight, Linnæus maintains, that, this circumſtance notwithſtanding, they propagate their ſpecies by a regular and uniform commerce of ſexes. "As it has been proven (ſays he) that all thoſe plants whoſe organs of generations are viſible, propagate their ſpecies by male and female embraces; therefore all thoſe whoſe organs are leſs ſubject to our obſervation, muſt likewiſe propagate in the ſame way." Before ſuch reaſoning as this can admit even of a decent apology, before the ſexualiſts attempt to ſhew that ſuch plants enjoy the faculty of generation, it is incumbent on them to prove that they are poſſeſſed of generating organs.

According to the doctrine of ſexes in vegetables, another capital defect, or rather redundance, occurs in the analogy between the animal and vegetable. It is one of the moſt benevolent and uſeful laws in nature, that *mules*, or ſuch animals as are produced by the unnatural commixtures of two different kinds, are deprived of the capacity of propagating their *monſtrous* ſpecies. It is true, Linnæus's *mules* are not obliged to comply with this law; they are not animal but *vegetable mules*; and conſequently may freely tranſmit their *monſtrous iſſue* to poſterity! As they are not objects of rewards or puniſhments, they cannot be anſwerable for the horrid conſequences of turning the whole vegetable world into confuſion, and covering the face of the earth with monſters horrible to behold!

It is a trite obſervation, that no fault is more common among bad writers than to render their arguments ridiculous by hunting down metaphors or analogies till every ſhadow of reſemblance be loſt. It is equally true, that this blunder occurs in almoſt every page of Linnæus's works. But it is peculiarly unlucky when an analogy is of ſuch a nature that it neceſſarily runs into obſcenity when treated in this manner. In purſuing a ſexual analogy, the utmoſt delicacy of expreſſion is required. This however is exceedingly difficult, eſpecially when the analogy is puſhed beyond its natural limits. But, in peruſing the *Sponſalia Plantarum*, one would be tempted to think, that the author had more reaſons than one for reliſhing this analogy ſo highly. In many parts of this treatiſe, there is ſuch a degree of indelicacy in the expreſſion as cannot be exceeded by the moſt obſcene romance-writer. For example, in p. 103. he ſays, "The "calix is the *bride-chamber* in which the ſtamina and "piſtilla ſolemnize their nuptials;" "Vel, ſi mavis "CUNNUS, ſeu LABIA ejuſdem, inter quæ organa "genitalia maſculina & feminina, delicatiſſimæ iſtæ partes, "foventur & ab externis injuriis muniuntur!—*Corolla* "eſt *aulæum*, vel potius *nymphæ!*—*Filamenta* ſunt *vaſa* "*ſpermatica*, quibus ſuccus ex planta ſecretus in an-"theras transfertur!—*Antheræ* ſunt TESTICULI.—"*Pollen*, ſeu pulvis antherarum, *genituræ* & *vermiculis* "*ſeminalibus* reſpondet.—Stigma eſt *vulva*, in qua "agit *genitura* maris, quæque hanc excipit.—*Stylus* eſt "*vagina*, vel potius pars illa quæ *tubæ Fallopianæ* re-"ſpondet.—*Germen* eſt *ovarium*; continet etiam ſemina "ſubventanea ſeu non fœcundata ante *copulam*.—*Peri-*"*carpium* eſt *ovarium fœcundatum*."—In p. 90, *&c.* we meet with *virginea vulva laſcive* hians—*æſtra venerea* "*agitata, piſtillum ſtigmate hiat*, RAPACIS INSTAR "DRACONIS, nil niſi maſculinum pulverem affectans." *&c.* It is impoſſible to do juſtice to theſe expreſſions in any tranſlation.

Beſides the obſcenity of theſe paſſages, it would be no difficult taſk to ſhow that the analogies are entirely without foundation. The calix is made to repreſent no leſs than three things of very oppoſite natures; firſt, it is analogous to the *chamber of the bride*, then to the *female organ*, and laſt of all to the LABIA. What analogy is there betwixt the *corolla* of a plant and the *nymphæ* of an animal? Where is the analogy between the *pollen* and the animalcules *in ſemine maſculino?* &c.

There is not any ſcience which has ſo little connection with theory as botany. Theory may perplex and confound, but never can have the leaſt tendency to aſſiſt the botanic ſtudent. A man would not naturally expect to meet with diſguſting ſtrokes of obſcenity in a ſyſtem of botany. But it is a certain fact, that obſcenity is the very baſis of the Linnæan ſyſtem. The names of his claſſes, orders, *&c.* convey often the vileſt and moſt unnatural ideas. For example, *diandria*, the name of his ſecond claſs, is thus explained by Linnæus, "mariti "duo in eodem conjugio; ſeu ſtamina duo in flore hermaphrodito;" *i. e. one female married to two males; or two ſtamina in a hermaphrodite flower.* The number of males goes on increaſing till the 13th claſs, the plants belonging to which are ſaid to have from 20 to 1000 huſbands to one wife!—We might aſk Linnæus, where is the analogy in this ſuppoſition? The ſyngeneſia claſs is thus defined by Linnæus: "Mariti genitalibus fœdus "conſtituerunt; ſeu ſtamina antheris in cylindrum coa-"lita;" *i. e. the males have made a covenant with their teſtes; or the ſtamina are united by the antheræ in the form of a cylinder.* The characters of the orders are ſtill worſe. *Polygamia fruſtranea*, the name of an order of the ſyngeneſia claſs, is thus defined: "Fruſtranea di-"citur, cum feminæ maritatæ, fertiles ſunt, et ſpeciem "propagare queunt; caſtratæ, impregnari nequeunt." Men or philoſophers can ſmile at the nonſenſe and abſurdity of ſuch obſcene gibberiſh; but it is eaſy to gueſs what effects it may have upon the young and thoughtleſs.

But the bad tendency upon morals is not the only evil produced by the ſexual theory. It has loaded the beſt ſyſtem of botany that has hitherto been invented, with a profuſion of fooliſh and often unintelligible terms, which throw an obſcurity upon the ſcience, obſtruct the progreſs of the learner, and deter many from ever entering upon the ſtudy.

Upon the whole, we muſt conclude, that the diſtinction of ſexes among vegetables has no foundation in nature; or, at leaſt, that the facts and arguments employed in ſupport of this doctrine, when examined with any degree of philoſophical accuracy, are totally inſufficient to eſtabliſh it.

BOTARGO, a kind of ſauſage, made with the eggs and blood of the ſea-mullet, a large fiſh common in the Mediterranean. The beſt kind comes from Tunis in Barbary: It muſt be choſen dry and reddiſh. The people of Provence uſe a great deal of it, the common way of eating it being with olive oil and lemon juice. There is alſo a great conſumption of botargo throughout all the Levant.

Botargo pays on importation $2\frac{87}{100}$d. the pound; whereof $2\frac{58}{100}$d. is repaid on exportation.

BOTATRISSA, in ichthyology, a ſynonime of a ſpecies of gadus. See GADUS.

BOTE, in our old law books, ſignifies recompence or amends: Thus man-bote, is a compenſation for a man ſlain.

There are likewiſe houſe-bote and plough-bote, privileges to tenants, of cutting wood for making ploughs, repairing tenements, and likewiſe for fuel.

BOTELESS, or BOOTLESS, is when an offender was ſaid to be without emendation, when no favour can acquit him; as in the caſe of ſacrilege.

BOTHNIA, the name of two provinces in Sweden, diſtinguiſhed by the epithets eaſt and weſt, and lying on each ſide the Bothnic gulf, which takes its name from them.

BOTRYTIS, in botany, a ſynonime of a ſpecies of mucor. See MUCOR.

BOTTLE, a veſſel proper to contain liquors, made of leather, glaſs, or ſtone. There are bottles of boiled leather, which are made and ſold by the caſe-makers. Thoſe among the ancient Hebrews were generally made of goat ſkin, with the hair on the inſide, well pitched and ſewed together; the mouth of the bottle was through the animal's paw that furniſhed the matter of it.

There are now in uſe bottles of fine glaſs which are commonly covered with ozier, and others of thick glaſs which are not covered. Formerly all thoſe bottles made in France held exactly a pint Paris meaſure (or about a quart of our Engliſh wine meaſure); but ſince the tavern-keepers ſell moſt of their wine in ſuch bottles, notwithſtanding an ordonnance to the contrary, that one would think the glaſſmakers had entered into an agreement with them not to make any bottles that hold the full meaſure, there are none but what hold leſs, and ſome conſiderably ſo. See GLASS-MAKING.

In commerce, bottles of earth or ſtone pay $11\frac{55}{100}$d. each dozen, on importation; whereof $10\frac{12}{100}$d. is repaid on exporting them. Glaſs bottles covered with wicker, pay 6 s. $7\frac{95}{100}$d. the dozen; whereof 6 s. $2\frac{25}{100}$d. is repaid on exporting them. Glaſs bottles covered with leather, pay 1 l. 9 s. $11\frac{77}{100}$d. the dozen; whereof 1 l. 7 s. $10\frac{12}{100}$d. is repaid on exporting them. Glaſs bottles uncovered, pay 1 s $5\frac{98}{100}$d. the dozen; 1 s. $4\frac{70}{100}$d. being repaid on exporting them. Bottles made of flint-glaſs, pay 8 d. for each pound weight; and thoſe made of green glaſs, only 2 d. for each pound weight. Bottles made of wood, called *ſucking-bottles*, pay by the groſs, or twelve dozen, 1 s. $11\frac{10}{100}$d; whereof 1 s. $8\frac{25}{100}$d. is repaid on exporting them.

BOTTOM, in a general ſenſe, denotes the loweſt part of a thing, in contradiſtinction to the top, or uppermoſt part.

BOTTOM, in navigation, is uſed to denote as well the channel of rivers and harbours, as the body or hull of a ſhip: Thus, in the former ſenſe, we ſay, a gravelly bottom, clayey bottom, ſandy bottom, &c. and in the latter ſenſe, a Britiſh bottom, a Dutch bottom, &c.

By ſtatute, certain commodities imported in foreign bottoms pay a duty called petty cuſtoms, over and above what they are liable to if imported in Britiſh bottoms.

BOTTOMRY, in commerce, a marine contract for the borrowing of money upon the keel or bottom of a ſhip, that is to ſay, when the maſter of a ſhip binds the ſhip itſelf, that if the money be not paid by the time appointed, the creditor ſhall have the ſaid ſhip.

BOTTOMRY is alſo where a perſon lends money to a merchant, who wants it in traffic, and the lender is to be paid a greater ſum at the return of the ſhip, ſtanding to the hazard of the voyage. On which account, though the intereſt be greater than what the law commonly allows, yet it is not uſury, becauſe the money being furniſhed at the lender's hazard, if the ſhip periſhes, he ſhares in the loſs.

BOTTONY. A croſs bottony, in heraldry, terminates at each end in three buds, knots or buttons, reſembling, in ſome meaſure, the three-leaved graſs: on which account Segoing, in his *Treſor Heraldique*, terms it *croix treffl e*. It is the badge of the order of St Maurice. See Plate LI. fig. 17.

BOTWAR, a town of Wirtemburg, in the circle of Swabia in Germany, ſituated about fifteen miles ſouth-eaſt of Hailbron: E. long. 9° 15′, and N. lat. 49°.

BOTZEN, a very beautiful town of Germany, in the Tyroleſe.

BOTZENBOURG, a town of Germany, ſituated upon the Elbe, in the duchy of Mecklenburg, in 11° 23′ E. long. and 53° 34′ N. lat.

BOVA, a town of the kingdom of Naples in Italy, about twenty miles ſouth eaſt of Reggio: E. long. 16° 15′, and N. lat. 38° 20′.

BOUCHAIN, a fortified town of Hainalt, in the French Netherlands, about ſeven miles north of Cambray: E. long 3° 15′, and N. lat. 50° 30′.

BOUCHE *of court*, the privilege of having meat and drink at court, ſcot free. This privilege is ſometimes only extended to bread, beer, and wine; and was anciently in uſe as well in the houſes of noblemen, as in the king's court.

BOUGE, in commerce, a ſort of fine, white, and clear ſtamine, of which ſhirts are made for moſt of the monks, who uſe none made of linen.

BOUGH denotes much the ſame with branch. See BRANCH.

BOUILLON, a ſtrong town with a caſtle, about three leagues from Sedan, on the river Semoy: It is capital of a duchy of the ſame name, ſituated between the duchy

duchy of Luxemburg and biſhoprick of Liege: E. lon. 5°, and N. lat. 49° 49′.

Bouillon, in the menage, a lump or excreſcence of fleſh, that grows either upon, or juſt by, the fruſh, inſomuch that the fruſh ſhoots out, juſt like a lump of fleſh, and makes the horſe halt; and this we call the fleſh blowing upon the fruſh. Menage horſes, that never wet their feet, are ſubject to theſe excreſcences, which make them very lame. See Frush.

BOVINES, a ſmall town in the province of Namur, in the Auſtrian Netherlands, about ten miles ſouth of Namur: E. long. 4° 50′, and N. lat. 50° 20′.

BOVINO, a ſmall city of the Capitonate, in the kingdom of Naples, about ſixty miles eaſt of the city of Naples: E. long. 16° 15′, and N. lat. 41°.

BOVISTA, in botany, a ſynonime of the lycoperdon. See Lycoperdon.

BOULDER-*wall*, a kind of wall built of round flints or pebbles, laid in a ſtrong mortar, and uſed where the ſea has a beach caſt up, or where there are plenty of flints.

BOULETTE, in the menage. A horſe is called *boulette*, when the fetlock, or poſtern-joint, bends forward, and out of its natural ſituation; whether through violent riding, or by reaſon of being too ſhort jointed, in which caſe the leaſt fatigue will bring it.

BOULOGNE, or Bologne, a port-town of France, ſituated in the province of Picardy, on the Engliſh channel: E. long. 1° 30′, and N. lat. 50° 40′.

BOULTINE, a term which workmen uſe for a moulding, the convexity of which is juſt one fourth of a circle, being the member next below the plinth in the Tuſcan and Doric capital.

BOUNCE, in ichthyology, the Engliſh name of a ſpecies of ſqualus. See Squalus.

BOUNDS *of lands*. See Abuttals.

BOUNTY, in commerce, a premium paid by the government to the exporters of certain Britiſh commodities, as ſail-cloth, gold and ſilver lace, ſilk ſtockings, fiſh, corn, &c.

The happy influence which bounties have on trade and manufactures is well known: Nor can there be a more convincing proof of the good intentions of the government under which we live, than the great care that is taken to give all poſſible encouragement to thoſe who ſhall eſtabliſh, or improve, any hazardous branch of trade.

BOURBON, or Mascarenha, an iſland in the Indian ocean, about one hundred miles eaſt of Madagaſcar, and ſubject to France: E. long. 54°, and S. lat. 21°.

Bourbon-archebaut, the capital of the duchy of Bourbon, in the Lyonois, in France: E. long. 3° 10′, and N. lat. 46° 35′.

Bourbon-lancy, a town of Burgundy, in France; in 3° 46′ E. long. and 46° 33′ N. lat.

BOURBOURG, or Bourborch, a town of the French Netherlands, about 10 miles ſouth-weſt of Dunkirk; in 2° 10′ E. long. and 50° 50′ N. lat.

BOURDEAUX, the capital of all Guienne and Gaſcony, ſituated on the river Garonne, in 40′ W. long. and 44° 50′ N. lat.

BOURDINES, a town of the Auſtrian Netherlands, 10 miles north-eaſt of Namur; in 5° E. long. and 50° 35′ N. lat.

BOURDONE'E, in heraldry, the ſame with pomée. See Pome'e.

BOURG, the capital of the iſland of Cayenne, a French colony on the coaſt of Guiana, in South America; in 52° W. long. and 5° N. lat.

BOURG-en-bress, the capital of Breſſe, in the province of Burgundy, in France, 36 miles W. of Geneva, and 32 north of Lyons; in 5° 5′ E. long. 46° 20′ N. lat.

Bourg-sur-mer, a town of Guienne, in France, 15 miles north of Bourdeaux, in 3° W. long.

BOURGES, the capital of the territory of Berry, in the Orleanois, in France, ſituated about 50 miles ſouth-eaſt of Orleans; in 2° 30′ W. long. and 47° 10′ N. lat.

BOURGET, a town of Savoy, ſix miles north of Chamberry; 5° 55′ E. long. and 45° 45′. N. lat.

BOURIGNONISTS, the name of a ſect among the Low Country Proteſtants, being ſuch as follow the doctrine of Antoinette Bourignon, a native of Liſle, an apoſtate of the Roman Catholic religion.

The principles of this ſect bear a very near reſemſemblance to thoſe of the Quietiſts or Quakers.

BOURO, an iſland in the Indian Ocean, ſubject to the Dutch; E long. 124°, and S. lat. 3° 30′.

BOUT, in the manege. A horſe is ſaid to be a-bout, when he is overdone, and quite ſpent with fatigue.

BOUTANT, or Arch-boutant, in architecture, an arch, or part of an arch, abutting againſt the reins of a vault to prevent its giving way.

A pillar Boutant is a large chain or pile of ſtone, made to ſupport a wall, terrace, or vault.

BOUTE', in the menage. A horſe is called bouté, when his legs are in a ſtraight line from the knee to the coronet: Short-jointed horſes are apt to be bouté; and, on the other hand, long-jointed horſes are not.

BOUTON, an iſland in the Indian Ocean: E. long 121° 30′, and lying between 4° and 5° S. lat.

BOUVILLON, a city of Luxemburg, in the Auſtrian Netherlands, about 40 miles weſt of Luxemburg: E. long. 5° and N. lat. 49° 55°.

BOW, a weapon of offence made of ſteel, wood, horn, or other elaſtic ſubſtances, which, after being bent by means of a ſtring faſtened to its two ends, in returning to its natural ſtate, throws out an arrow with prodigious force.

The uſe of the bow is, without all doubt, of the earlieſt antiquity. It has likewiſe been the moſt univerſal of all weapons, having obtained amongſt the moſt barbarous and remote people, who had the leaſt communication with the reſt of mankind.

The figure of the bow is pretty much the ſame in all countries, where it has been uſed; for it has generally two inflexions or bendings, between which, in the place where the arrow is drawn, is a right line. The Grecian bow was in the ſhape of a Σ, of which form we meet with many, and generally adorned with gold or ſilver. The Scythian bow was diſtinguiſhed

ſtinguiſhed from the bows of Greece and other nations, by its incurvation, which was ſo great, as to form an half moon or ſemicircle. The matter of which bows were made, as well as their ſize, differed in different countries. The Perſians had very great bows made of reeds; and the Indians had alſo, not only arrows, but bows made of the reeds or canes of that country; the Lycian bows were made of the cornel tree; and thoſe of the Æthiopians, which ſurpaſſed all others in magnitude, were made of the palm-tree.

Though it does not appear, that the Romans made uſe of bows in the infancy of their republic, yet they afterwards admitted them as hoſtile weapons, and employed auxiliary archers in all their wars.

In drawing the bow, the primitive Grecians did not pull back their hand towards their right ear, according to the faſhion of modern ages, and of the ancient Perſians, but, placing their bow directly before them, returned their hand upon their right breaſt. This was alſo the cuſtom of the Amazons.

The bow is a weapon of offence amongſt the inhabitants of Aſia, Africa, and America, at this day; and in Europe, before the invention of fire-arms, a part of the infantry were armed with bows. Lewis XI. firſt aboliſhed the uſe of them in France, introducing, in their place, the halbard, pike, and broad ſword. The long bow was formerly in great vogue in England, and many laws were made to encourage the uſe of it. The parliament under Henry VII. complained of the diſuſe of long bows, heretofore the ſafeguard and defence of this kingdom, and the dread and terror of its enemies.

Bow is alſo an inſtrument formerly uſed at ſea for taking the ſun's altitude; conſiſting of a large arch of ninety degrees graduated, a ſhank or ſtaff, a ſhade vane, a ſight vane, and an horizon vane. It is now out of uſe.

Bow, among builders, a beam of wood or braſs, with three long ſcrews, that direct a lath of wood or ſteel to any arch; chiefly uſed in drawing draughts of ſhips, and projections of the ſphere; or where-ever it is requiſite to draw large arches.

Bow, in muſic, a ſmall machine, which, being drawn over the ſtrings of a muſical inſtrument, makes it reſound. It is compoſed of a ſmall ſtick, to which are faſtened eighty or an hundred horſe-hairs, and a ſcrew which ſerves to give theſe hairs the proper tenſion. In order that the bow may touch the ſtrings briſkly, it is uſual to rub the hairs with roſin.

Bow, among artificers, an inſtrument ſo called from its figure; in uſe among gunſmiths, lockſmiths, watchmakers, *&c.* for making a drill go. Among turners, it is the name of that pole fixed to the ceiling, to which they faſten the cord that whirls round the piece to be turned.

Bow-staves, imported from the Britiſh plantations, are free; if from Ireland, Aſia, or Africa, they pay 15 s. $4\frac{80}{100}$d. for every 120; and if from any other country, 1 l. 2 s. $10\frac{80}{100}$d. for the ſame number.

Bows *of a ſaddle* are two pieces of wood laid archwiſe to receive the upper part of a horſe's back, to give the ſaddle its due form, and to keep it tight.

The fore-bow, which ſuſtains the pommel, is compoſed of the withers, the breaſts, the points or toes, and the corking. See Withers, *&c.*

The hind-bow bears the trouſequin or quilted roll. The bows are covered with ſinews, that is, with bulls pizzels beaten, and ſo run all over the bows to make them ſtronger. Then they are ſtrengthened with bands of iron to keep them tight, and, on the lower ſide, are nailed on the ſaddle-ſtraps, with which they make faſt the girths.

Bow *of a ſhip*, that part which begins at the loof, and compaſſing ends of the ſtem, and ends at the ſternmoſt part of the fore-caſtle.

If a ſhip have a broad round bow, they call it a bold bow. If ſhe has a narrow thin bow, they ſay ſhe has a lean bow.

Bow-line. See Bowling.

Bow-pieces are the pieces of ordinance at the bow of a ſhip.

Rain-bow. See Rain-bow, and Optics.

Bow-bearer, an inferior officer of the foreſt, who is ſworn to make inquiſition of all treſpaſſes againſt vert or veniſon, and to attack offenders.

BOWE, a market-town of Devonſhire, about twelve miles north-weſt of Exeter; W. long. 4°, and N. lat. 50° 45′.

BOWELS, in anatomy, the ſame with inteſtines. See p. 259, *&c.*

BOWER, in gardening, a place under covert of trees, differing only from an arbour, as being round or ſquare, and made with a kind of dome or ceiling at top; whereas the arbour is always built long and arched.

Bower, in the ſea-language, the name of an anchor carried at the bow of a ſhip. There are generally two bowers, called firſt and ſecond, great and little, or beſt and ſmall bower. See Anchor.

BOWESS, or Bowet, in falconry, a young hawk, when ſhe draws any thing out of her neſt, and covets to clamber on the boughs.

BOWGE, or Bouche *of court*. See Bouche.

BOWL denotes either a ball of wood, for the uſe of bowling; or a veſſel of capacity, wherein to hold liquors.

Bowls and buckets of wood, imported, pay a duty of $9\frac{57}{100}$d. the dozen; whereof $8\frac{62}{100}$d. is repaid on exporting them.

BOWLDER-*ſtones*, ſmall ſtones, of a roundiſh figure, and no determinate ſize, found on the ſea-ſhore and banks or rather channels of rivers.

BOWLING, the art of playing at bowls. The firſt thing to be obſerved in bowling is, the right chuſing your bowl, which muſt be ſuitable to the ground you deſign to run on. Thus, for cloſe alleys, the flat bowl is the beſt; for open grounds of advantage, the round biaſſed bowl; and for plain and level ſwards, the bowl that is as round as a ball. The next is to chuſe your ground; and, laſtly, to diſtinguiſh the riſings, fallings, and advantages of the places where you bowl.

Bowling, or Bow-line, in a ſhip, a rope made faſt to the leech or middle part of the outſide of the ſail: it is faſtened by two, three, or four ropes, like a crow's foot,

foot, to as many parts of the fail; only the mizen bow-line is faftened to the lower end of the yard. This rope belongs to all fails, except the fprit-fail and fprit top-fail. The ufe of the bow-line is to make the fails ftand fharp or clofe, or by a wind.

Sharp the bow-line, is hale it taught, or pull it hard. Hale up the bow-line, that is, pull it harder forward on. Check or eafe, or run up the bow-line, that is, let it be more flack.

Bowling-*bridles*, are the ropes by which the bow line is faftened to the leech of the fail.

Bowling-*knot*, a knot that will not flip, by which the bow-line bridle is faftened to the cringles.

Bowling-*green*, a kind of parterre, laid with fine turf, defigned for the exercife of bowling. See Bowling.

BOW-*net*, among fportfmen. See Net.

Bow-*faw*, among artificers. See Saw.

BOWSE, in the fea-language, fignifies as much as to hale or pull. Thus bowfing upon a tack, is haling upon a tack. Bowfe away, that is, pull away all together.

Bow-sprit, or Bolt-sprit, a kind of maft, refting flopewife on the head of the main ftern, and having its lower end faftened to the partners of the fore-maft, and farther fupported by the fore-ftay. It carries the fprit-fail, fprit top-fail, and jak-ftaff; and its length is ufually the fame with that of the fore-maft.

Bow-sprit-ladder. See Ladder.

BOWYERS, artificers whofe employment or occupation it is to make bows. There is a company of bowyers in the city of London, firft incorporated in 1623.

BOX, in its moft common acceptation, denotes a fmall cheft or coffer for holding things.

Fire-boxes, or tinder-boxes, pay, on importation, a duty of 3 s. $10\frac{20}{100}$d. the grofs; whereof 3 s. $4\frac{1}{2}$d. is repaid on exportation. Wooden money-boxes pay 3 s. $7\frac{8}{100}$d. the grofs; whereof 3 s. $2\frac{8}{100}$d. is repaid on exportation. Neft-boxes pay 11 s. $6\frac{60}{100}$d. the grofs; whereof 10 s. $1\frac{1}{2}$d. is repaid. Pepper-boxes pay 4 s. $3\frac{97}{100}$d.; whereof 3 s. $9\frac{56}{100}$d. is repaid. French boxes, for marmalade or jelly, pay each dozen 3 s. $\frac{55}{100}$d.; whereof 1 s. $9\frac{76}{100}$d. is repaid. Sand-boxes pay 3 s. $10\frac{20}{100}$d. the grofs; whereof 3 s. $4\frac{1}{2}$d. is repaid. Snuff-boxes, if of wood, pay 2 s. $4\frac{72}{100}$d. the dozen; whereof 2 s. $1\frac{87}{100}$d. is repaid: if of horn, they pay 4 s. $9\frac{45}{100}$d. the dozen; 4 s. $3\frac{75}{100}$d. being drawn back: if of ivory or tortoife-fhell, they pay 9 s. $6\frac{90}{100}$d. the dozen; whereof 8 s. $7\frac{1}{2}$d. is drawn back. Soap-boxes pay 7 s. $8\frac{40}{100}$d. the fhock, containing fixty boxes. Spice-boxes pay 1 s. $1\frac{86}{100}$d. the dozen. Tobacco-boxes, pay 5 s. $9\frac{30}{100}$d. the grofs. Touch-boxes, covered with leather, pay only $6\frac{93}{100}$d. the dozen; but if the leather be the moft valuable part, they pay 6 s. $11\frac{25}{103}$d. for every 20 s. value upon oath: if covered with velvet, they pay 2 s. $10\frac{65}{100}$d. the dozen: and if of iron, or other metal gilt, they pay 3 s. $10\frac{20}{100}$d. the dozen: in all which cafes, a proportionable draw-back is allowed.

Box is alfo ufed for an uncertain quantity or meafure: thus a box of quickfilver contains from one to two hundred weight; a box of prunellas, only 14 pounds; a box of rings for keys, two grofs, *&c.*

Box *of a plough*, the crofs-piece in the head of a plough, which fupports the two crow-ftaves. See Plough.

Box, or Box-tree, in botany, the Englifh name of the buxus. See Buxus.

BOXBERG, a town of Germany in Franconia, belonging to the elector palatine.

BOXTEL, a town of Dutch Brabant, fituated on the river Bommel, about eight miles fouth of Boifleduc, in 5° 16′ E. long. and 51° 30′ N. lat.

BOXTHUDE, a town of the duchy of Bremen, in Germany, about fifteen miles weft of Hamburgh, and fubject to the elector of Hanover; E. long. 9° 16′, and N. lat. 53° 50′.

BOYAR, a term ufed for a grandee of Ruffia and Tranfylvania.

Becman fays, that the boyars are the upper nobility; and adds, that the Czar of Mufcovy, in his diplomas, names the boyars before the waywodes. See Waywode.

BOYAU, in fortification, a ditch covered with a parapet, which ferves as a communication between two trenches. It runs parallel to the works of the body of the place, and ferves as a line of contravallation, not only to hinder the fallies of the befieged, but alfo to fecure the miners. But when it is a particular cut that runs from the trenches to cover fome fpot of ground, it is drawn fo as not to be enfiladed, or fcoured by the fhot from the town.

BOYER, a fmall veffel of burden, refembling a fmack, with only one maft and a bolt-fprit.

BOYES, idolatrous priefts among the favages of Florida.

Every prieft attends a particular idol, and the natives addrefs themfelves to the prieft of that idol to which they intend to pay their devotion.

The idol is invoked in hymns, and his ufual offering is the fmoke of tobacco.

BOYNE, a river of Ireland, which, taking its rife in Queen's county, in the province of Leinfter, runs north-eaft by Trim and Cavan, and falls into the Irifh channel, a little below Drogheda.

BOZOLO, a town of the duchy of Mantua, about 12 miles fouth-weft of that city; E. long. 11°, and N. lat. 44° 40′.

B QUADRO, Quadrato, or Durale, in mufic, called by the French *b quarre*, from its figure ♮. This is what we call B natural or fharp, in diftinction to B mol or flat. See Flat, and Sharp.

If the flat ♭ be placed before a note in the thorough bafs, it intimates, that its third is to be minor; and if placed with any cipher over a note in the bafs, as ♭6, or ♭5, *&c.* it denotes, that the fifth or fixth thereto are to be flat. But if the quadro ♮ be placed over any note, or with a cipher, in the thorough bafs, it has the contrary effect; for thereby the note or interval thereto is raifed to its natural order.

BRABANT, a large province of the Netherlands, lying eaftward of Flanders; the greater part of it is fubject to

to the houſe of Auſtria, the capital Bruſſels; and the reſt to the Dutch, their capital Breda.

BRABEJUM, in botany, a genus of the tetrandria monogynia claſs. The corolla is below the fruit, and conſiſts of four petals. It has no calix; the fruit is a hairy drupe, of an oval figure. There is only one ſpecies, *viz.* the ſtellatiferum, a native of Æthiopia.

BRABEUTES, or BRABEUTA, in antiquity, an officer among the Greeks, who preſided at the public games, and decided controverſies that happened among the antagoniſts in the gymnaſtical exerciſes. The number of brabeutæ was not fixed; ſometimes there was only one, but more commonly they amounted to nine or ten.

BRACCIANO, a town of St Peter's patrimony, about twelve miles north of Rome, ſituated on the weſt ſide of a lake, to which it gives name; E. long. 13°, and N. lat. 42°.

BRACE is commonly taken for a couple or pair, and applied by huntſmen to ſeveral beaſts of game, as a brace of bucks, foxes, hares, *&c.*

BRACE, or BRASSE, is alſo a foreign meaſure, anſwering to our fathom. See FATHOM.

BRACE, in architecture, a piece of timber framed in with bevil joints, the uſe of which is to keep the building from ſwerving either way. When the brace is framed into the kingleſſes or principal rafters, it is by ſome called a ſtrut.

BRACES, in the ſea-language, are ropes belonging to all the yards of a ſhip, except the mizen, two to each yard, reeved through blocks that are faſtened to pennants, ſeized to the yard-arms. Their uſe is either to ſquare, or traverſe the yards. Hence to brace the yard, is to bring it to either ſide. All braces come aftward on, as the main-brace comes to the poop, the main-top-ſail brace comes to the mizen-top, and thence to the main ſhrouds: The fore and fore-top-ſail braces come down by the main and main-top-ſail ſtays, and ſo of the reſt. But the mizen-bowline ſerves to brace to the yard, and the croſs-jack braces are brought forwards to the main ſhrouds, when the ſhip ſails cloſe by a wind.

BRACED, in heraldry, a term for the intermingling three cheveronels. See Plate LI. fig. 18.

BRACELET, an ornament worn on the wriſt, much uſed among the ancients: It was made of different materials, and in different faſhions, according to the age and quality of the wearer.

Bracelets are ſtill worn by the ſavages of Africa, who are ſo exceſſively fond of them, as to give the richeſt commodities and even their fathers, wives, and children, in exchange for thoſe made of no richer materials than ſhells, glaſs, beads, and the like

Bracelets of glaſs pay 3 s. $8\frac{11}{20}$ d. the ſmall groſs, containing twelve bundles or dickers; and, if of the French manufacture, they pay 4 s. $1\frac{16}{20}$ d. for the ſame quantity: A proportionable drawback is allowed in each caſe.

BRACHIÆUS, in anatomy, the name of a muſcle. See p. 197.

Coraco-BRACHIALIS, in anatomy, the name of a muſcle. See p. 196.

BRACHIONUS, in zoology. See LABELLA.

BRACHIUM, or ARM, in anatomy, one of the ſuperior extremities of the human body, comprehending the SCAPULA, the OS HUMERI, the CUBIT, and the HAND. See theſe articles.

BRACHMINS, a ſect of Indian philoſophers known to the ancient Greeks by the name of *Gymnoſophiſts*. The ancient brachmins lived upon herbs and pulſe, and abſtained from every thing that had life in it. They lived in ſolitude without matrimony, and without property: and they wiſhed ardently for death, conſidering life only as a burden. The modern brachmans make up one of the caſts or tribes of the banians. They are the prieſts of that people, and perform their office of praying and reading the law, with ſeveral mimical geſtures, and a kind of quavering voice. They believe, that, in the beginning, nothing but God and the water exiſted, and that the ſupreme Being, deſirous to create the world, cauſed the leaf of a tree, in the ſhape of a child playing with its great toe in its mouth, to float on the water. From its navel there iſſued out a flower, whence Brama drew his original, who was intruſted by God with the creation of the world, and preſides over it with an abſolute ſway. They make no diſtinction between the ſouls of men and brutes, but ſay the dignity of the human ſoul conſiſts in being placed in a better body, and having more room to diſplay its faculties. They allow of rewards and puniſhments after this life; and have ſo great a veneration for cows, that they look on themſelves as bleſſed, if they can but die with the tail of one of them in their hand. They have preſerved ſome noble fragments of the knowledge of the ancient brachmans They are ſkilful arithmeticians, and calculate, with great exactneſs, eclipſes of the ſun and moon. They are remarkable for their religious auſterities. One of them has been known to make a vow, to wear about his neck a heavy colar of iron for a conſiderable time: Another to chain himſelf by the foot to a tree, with a firm reſolution to die in that place: And another to walk in wooden ſhoes, ſtuck full of nails on the inſide. Their divine worſhip conſiſts chiefly of proceſſions, made in honour of their deities. They have a college at Banara, a city ſeated on the Ganges.

BRACHYGRAPHY, the art of ſhort-hand writing. See SHORT-HAND.

BRACHYPTERA, a term uſed by Willoughby, to denote thoſe hawks which have their wings ſo ſhort, as not to reach to the end of the tail: Of this kind are the goſs hawk, ſparrow-hawk, *&c.*

BRACHYPYRENIA, in the hiſtory of foſſils, a genus of ſeptariæ, with a ſhort roundiſh nucleus. See SEPTARIÆ.

BRACHYTELOSTYLA, in natural hiſtory, the name by which Dr Hill calls thoſe cryſtals, which are compoſed of a ſhort hexangular column, terminated at each end by an hexangular pyramid. See CRYSTAL.

BRACKET, among carpenters, *&c.* a kind of wooden ſtay, ſerving to ſupport ſhelves, and the like.

BRACK-

BRACKETS, in a ſhip, the ſmall knees, ſerving to ſupport the galleries, and commonly carved. Alſo the timbers that ſupport the gratings in the head, are called brackets.

BRACKETS, in gunnery, are the cheeks of the carriage of a mortar: they are made of ſtrong planks of wood, of almoſt a ſemicircular figure, and bound round with thick iron plates; they are fixed to the beds by four bolts, which are called bed-bolts; they riſe up on each ſide of the mortar, and ſerve to keep her at any elevation, by means of ſome ſtrong iron bolts, called bracket-bolts, which go through theſe cheeks or brackets.

BRACKLAW, the capital of the palatinate of Bracklaw, in Podolia, in Poland, ſituated on the river Bog, an hundred and ten miles eaſt of Kaminec: E. long. 29° 20′, and N. lat. 48°.

BRACKLEY, a borough-town of Northamptonſhire, about fifteen miles ſouth-weſt of Northampton: W. lon. 1° 15′, and N. lat. 52°.

It ſends two members to parliament.

BRACTEA, in natural hiſtory, denotes a ſpangle, or thin flake of any ſubſtance.

BRACTEA, in botany. See FLORAL LEAF.

BRACTEARIA, in natural hiſtory, a genus of talcs, compoſed of ſmall plates in form of ſpangles, each plate either being very thin, or fiſſile into very thin ones.

Of this genus there are a great many ſpecies, called, from their different colours, *mica aurea*, or gold-glimmer; and *mica argentea*, ſilver-glimmer, or cats-ſilver, *&c.*

BRAD, in geography, a town of Sclavonia, ſituated on the north ſide of the river Save, eighteen miles ſouth of Poſega: E. long. 18° 40′, and N. lat. 45° 20′.

BRADFIELD, a market-town in Eſſex, fourteen miles north of Chelmsford: E. long. 30′, and N. lat. 51° 51′.

BRADFORD, a market-town in Wiltſhire, about nine miles weſt of the Devizes: E. long. 2° 40′, and N. lat. 51° 20′.

BRADFORTH, a market town of Yorkſhire, thirty miles ſouth-weſt of York: W. long. 1° 35′, and N. lat. 53° 40′.

BRADNICH, a market town of Devonſhire, ten miles north of Exeter: W. long. 3° 35′, and N. lat. 50° 45′.

BRADS, among artificers, a kind of nails uſed in building, which have no ſpreading heads, as other nails have. They are diſtinguiſhed, by iron-mongers, by ſix names, as joiner's-brads, flooring brads, batten-brads, bill-brads, or quarter heads, *&c.* Joiner's-brads are for hard wainſcot, batten brads are for ſoft wainſcot; bill-brads are uſed when a floor is laid in haſte, or for ſhallow joiſts ſubject to warp. See NAIL.

BRADYPUS, or ſloth, a genus of quadrupeds belonging to the order of bruta. The characters are theſe: They have no fore-teeth in either jaw; the dog-teeth are blunt, ſolitary, and longer than the grinders; they have five grinders on each ſide. The body is covered with hair. There are only two ſpecies of bradypus, *viz.* 1. The tridactylis, or American ſloth, has a ſhort tail, and only three toes on each foot. It is about the ſize of a fox. The body is covered over with hair of a grey colour; the face is naked; the throat is yellowiſh; the fore-feet are longer than the hind-feet; the claws, which are three on each foot, are compreſſed, and very ſtrong; and they have no mammæ on the breaſt; they have no external ears, but only two winding holes. This ſpecies is a native of America, and feeds upon the tender leaves of trees, and particularly the leaves of the cecropia. It never drinks, and is terrified at rain. It climbs trees with great eaſe; but its motion on the ground is ſo ſlow, that it can hardly walk fifty paces in a day, and from this circumſtance it is called a *Sloth*. It makes a moſt diſagreeable noiſe, reſembling that of a young cat. See Plate LIX. fig. 1. 2. The didactylus, or Ceylon ſloth, has two toes on each foot, and no tail: The head is round; the ears are large; and it has two mammæ on the breaſt: The body is covered with aſh-coloured hair. It has the ſame diſagreeable cry with the American ſloth, and is a native of Ceylon.

BRAG, an ingenious and pleaſant game at cards, where as many may partake as the cards will ſupply; the eldeſt hand dealing three to each perſon at one time, and turning up the laſt card all round. This done, each gameſter puts down three ſtakes, one for each card. The firſt ſtake is won by the beſt card turned up in the dealing round; beginning from the ace, king, queen, knave, and ſo downwards. When cards of the ſame value are turned up to two or more of the gameſters, the eldeſt hand gains; but it is to be obſerved, that the ace of diamonds wins, to whatever hand it be turned up.

The ſecond ſtake is won by what is called the brag, which conſiſts in one of the gameſters challenging the reſt to produce cards equal to his: Now it is to be obſerved, that a pair of aces is the beſt brag, a pair of kings the next, and ſo on; and a pair of any ſort wins the ſtake from the moſt valuable ſingle card. In this part conſiſts the great diverſion of the game; for, by the artful management of the looks, geſtures, and voice, it frequently happens, that a pair of fives, treys, or even duces, out-brags a much higher pair, and even ſome pairs royal, to the no ſmall merriment of the company. The knave of clubs is here a principal favourite, making a pair with any other card in hand, and with any other two cards a pair royal.

The third ſtake is won by the perſon who firſt makes up the cards in his hand one and thirty; each dignified card going for ten, and drawing from the pack, as uſual in this game.

BRAGA, the capital of the province of Entre-minho-duro, in Portugal, ſituated on the river Cavado, 32 miles north of Porto; W. long. 8° 40′, and N. lat. 41° 20′.

BRAGANZA, a city of the province of Tralofmontes, in Portugal, ſituated on the river Sabor, in 7° W. long. and 41° 50′ N. lat.

BRAGGET, a kind of drink made of malt, honey, and ſpices, much uſed in Wales.

BRAIL, or BRAILS, in a ſhip, are ſmall ropes made

ufe of to furl the fails acrofs: They belong only to the two courfes and the mizen-fail; they are reeved through the blocks, feized on each fide the ties, and come down before the fail, being at the very fkirt thereof faftened to the cringles; their ufe is, when the fail is furled acrofs, to hale up its bunt, that it may the more eafily be taken up or let fall. Hale up the brails, or brail up the fail, that is, hale up the fail, in order to be furled or bound clofe to the yard.

BRAILOW, a town of Podolia, in Poland, fituated on the river Bog, 40 miles north of Bracklow; E. long. 29°, and N. lat. 48° 50′.

BRAIN, in anatomy. See p. 283, *&c.*

BRAIN LE COMPTE, a town of Hainalt, in the Auftrian Netherlands, fifteen miles fouth-eaft of Bruffels, and nine north-eaft of Mons; E. long. 4°, and N. lat. 50° 40′.

BRAINTREE, a market-town of Effex, 12 miles north of Chelmsford; E long. 35′, and N. lat. 51° 50′.

BRAKE denotes female fern, or the place where it grows: Alfo a fharp bit or fnaffle for horfes; and a baker's kneading trough: Alfo an inftrument with teeth, to bruife flax or hemp.

BRAKEL, a town of the bifhopric of Paderborn, in the circle of Weftphalia, in Germany; E. long. 9°, and N. lat. 51° 40′.

BRALROENS, one of the Sunda-iflands, lying north-eaft of Java, in 4° 30′ N. lat.

BRAMA, in ichthyology, the trivial name of a fpecies of cyprinus. See CYPRINUS.

BRAMANT, a town of Savoy, 35 miles north-weft of Turin; E. long. 6° 45′, and N. lat. 45°.

BRAMBER, a borough-town of Suffex, about 16 miles fouth-eaft of Grinfted; W. long. 15′, and N. lat. 50° 50′. It fends two members to parliament.

BRAMBLE, or BRAMLLE-BUSH, in botany, the Englifh name of the rubus. See RUBUS.

BRAMBLE-NET, otherwife called hallier, is a net to catch birds in, of feveral fizes; the great mafhes muft be four inches fqaure; thofe of the leaft fize are three or four inches fquare; and thofe of the biggeft five. In the depth, they fhould not be above three or four inches; but as for the length, they may be enlarged at pleafure; the fhorteft being eigtheen feet long.

BRAMBLE, or BRAMBLING, in ornithology, the Englifh name of a fpecies of fringilla. See FRINGILLA.

BRAMINS, the name of the priefts among the idolatrous Indians; the fucceffors of the ancient brachmans. See BRACHMANS.

BRAMPORE, a town of the Hither Peninfula of India; E. long. 77°, and N. lat. 21° 30′.

BRAMPTON, a market-town of Cumberland, about fix miles north-eaft of Carlifle; W. long. 2° 40′, and N. lat. 54° 50′.

BRAMYARD, a market-town of Herefordfhire, about 12 miles north-eaft of Hereford; W. long. 2° 30′, and N. lat. 52° 20′.

BRAN, the fkins or hufks of corn, efpecially wheat ground, feparated from the flour by a fieve or boulter.

It is of wheat-bran that ftarch-makers make their ftarch. The dyers reckon bran among the not-colouring drugs, and ufe it for making, what they call, *the four waters*, with which they prepare their feveral dyes.

BRANCH, in botany, an arm of a tree, or a part, which, fprouting out from the trunk, helps to form the head or crown thereof.

BRANCHES *of a bridle*, in the manege, are two pieces of iron bended, which, in the interval, between the one and the other, bear the bit-mouth, the crofs-chains, and the curb; fo that on one end they anfwer to the head-ftall, and on the other to the reins, in order to keep the horfe's head in fubjection. With regard to their form and ftructure, branches are either ftrait, in form of a piftol, for young horfes to form their mouth; or, after the conftable of France's fafhion, proper for a horfe that carries his head well. Some are in form of a gigot or leg, which will prevent horfes from carrying too low: Some in form of a bent knee, contrived for horfes that arm themfelves againft the operation of the bit; and others after the French fafhion, which is hardly about $\frac{1}{3}$ of an inch at the fevile hole, and kneed $1\frac{1}{4}$ inch at the jarret or ham.

It is to be obferved, 1. That the farther the branch is from an horfe's neck, the more effect it will have. 2. That fhort branches, *cæteris paribus*, are ruder, and their effects more fudden, than thofe of longer. 3. That the branch is to be proportioned to the length of a horfe's neck; and one may fooner err in chufing one too fhort than too long.

BRANCHES *of ogives*, in architecture, are the arches of Gothic vaults. Thefe arches traverfing from one angle to another diagonal wife, form a crofs between the other arches, which make the fides of the fquare, of which the arches are diagonals.

BRANCH *of a trench*. See BOYAU.

BRANCH *of a mine*. See GALLERY.

BRANCH-STAND, with falconers, a term ufed to fignify the making a hawk leap from tree to tree, till the dog fprings the game.

BRANCHER, among fportfmen, a young hawk, newly taken out of the neft, that can hop from bough to bough.

BRANCHIÆ, or GILLS, in the anatomy of fifhes, the parts correfponding to the lungs of land-animals, by which fifhes take in and throw out again a certain quantity of water, impregnated with air. All fifhes, except the cetaceous ones and the petromyzum, are furnifhed with thefe organs of refpiration; which are always eight in number, four on each fide the throat. That next the heart is always the leaft, the reft increafing in order as they ftand near the head of the fifh.

Each of thefe gills is compofed of a bony lamina, in form of a femicircle, for the moft part; and on its convex fide ftand the leaves or lamellæ, like fo many fickles. The whole convex part of the lamellæ is befet with hairs, which are longeft near the bafe, and decreafe gradually as they approach towards the point. There are alfo hairs on the concave fide of the lamellæ, but fhorter than the others, and continued only to its middle.

The

The convex fide of one lamina is fitted into the concave fide of the next fuperior one; and all of them are connected together by means of a membrane, which reaches from their bafe half-way their height, where it grows thicker, and in fome meafure refembles a rope. The reft of the lamina is free, and terminates in a very fine and flexible point.

As to the ufe of thefe gills, they feem to be defigned to receive the blood protruded from the heart into the aorta, and convey it into the extremities of the lamellæ; from whence being returned by veins, it is diftributed over the body of the fifh.

BRANCHIARUM *foramina*, apertures of the gills. In moft fifhes there is only one aperture; in the cartilaginous ones, thefe apertures are ten in number, five on each fide; and in the petromyzon or lamprey, there are no lefs than fourteen of thefe apertures, feven on each fide.

As to the cetacious fifhes, they have no aperture of this kind; and the reafon feems to be, becaufe they are furnifhed with lungs.

BRANCHIDÆ, in Grecian antiquity, priefts of the temple of Apollo, which was at Dydimus in Ionia, a province of leffer Afia, towards the Ægean fea, upon the frontiers of Caria. They opened to Xerxes the temple of Apollo, the riches whereof he took away. After which, thinking it unfafe to ftay in Greece, they fled to Sogdiana, on the other fide of the Cafpian fea, upon the frontiers of Perfia, where they built a city, called by their own name; but they did not efcape the punifhment of their crime: For Alexander the Great having conquered Darius king of Perfia, and being informed of their treachery, put them all to the fword, and razed their city, thus punifhing the impiety of the fathers in their pofterity.

BRANCHON, a town of the Auftrian Netherlands, about eight miles north of Namur: E. long. 4° 50′, and N. lat. 50° 32′.

BRANCHUS, a defluxion of humours upon the fauces, being a fpecies of catarrh.

BRANDEIS, a town of Bohemia, fituated on the river Elbe, ten miles north-eaft of Prague: E. long. 14° 25′, N. lat. 50° 15′.

BRANDENBURG, a city of the marquifate of Brandenburg in Germany, fituated on the river Havel, twenty-fix miles weft of Berlin: E. long. 13°, N. lat. 52° 25′.

It was once the capital of Brandenburg; but is now on the decline, fince Berlin fupplanted it.

BRANDON, a market-town of Suffolk, ten miles north of Bury: E. long. 45′, N. lat. 52° 30′.

It gives the title of duke to his grace the duke of Hamilton.

BRANDRITH, a trevet, or other iron utenfil, to fet a veffel on over the fire.

BRANDY, a fpirituous and inflammable liquor, extracted from wine and other liquors, by diftillation. See CHEMISTRY, *Of fpirituous fermentation, and diftilling.*

Wine-brandy, made in France, is efteemed the beft in Europe. They make it where-ever they make wine, and for that purpofe ufe wine that is pricked rather than good wine. The chief brandies for foreign trade, and thofe accounted beft, are the brandies of Bourdeaux, Rochelle, Cogniac, Charenton, the ifle of Rhe, Orleans, the county of Blafois, Poictou, Touraine, Anjou, Nantes, Burgundy, and Champaign.

BRANLIN, in ichthyology, a fpecies of falmon, with feveral tranfverfe black ftreaks, refembling the impreffion of fo many fingers.

BRANSKA, a town of Tranfilvania, fituated on the river Marifh: E. long. 23° 15′, and N. lat. 46°.

BRASEM, in ichthyology, a fifh otherwife called acara peba.

BRASIDIA, an anniverfary folemnity at Sparta, in memory of Brafidas, a Lacedæmonian captain, famous for his atchievments at Methone, Pylos, and Amphipolis. It was celebrated with facrifices and games, wherein none were permitted to contend, but free-born Spartans. Whoever neglected to be prefent at the folemnity was fined.

BRASIL, or BRAZIL, a large maritime country of South America, lying between 35° and 60° W. lon. and between the equator and 35° S. lat.

It is bounded by the Atlantic ocean and the river Amazon on the north, by the fame ocean on the eaft, by the river of Plate on the fouth, and by Paraguay on the weft; being computed to be 2500 miles in length, and 700 miles in breadth. The Portuguefe have now the fole dominion of this extenfive country, where, befides fugar and tobacco, there are rich mines of gold and diamonds; from whence his Portuguefe majefty draws a very confiderable revenue.

BRASIL *wood*, or BRAZIL-*wood*, an American wood of a red colour, and very heavy. It is denominated varioufly, according to the places from whence it is brought: Thus we have brafil from Fernambuco, Japan, Lamon, &c.

The brafil-tree ordinarily grows in dry barren places, and even in the cliffs of rocks: It is very thick and large, ufually crooked and knotty: Its flowers, which are of a beautiful red, exhale a very agreeable fmell.

Though the tree be very thick, it is covered with fo grofs a bark, that when the favages have taken it off, the wood or trunk, which was before the thicknefs of a man, is fcarce left equal to that of his leg.

This wood muft be chofen in thick pieces, clofe, found, without any bark on it, and fuch as, upon fplitting, of pale becomes reddifh, and, when chewed, has a faccharine tafte. It is much ufed in turned work, and takes a good polifh: But its chief ufe is in dying, where it ferves for a red colour: It is a fpurious colour, however, that it gives, and eafily evaporates and fades; nor is the wood to be ufed without alum and tartar. From the Brafil of Fernambuco, is drawn a kind of carmine, by means of acids: There is alfo a liquid lacca made of it, for miniature.

BRASLAW, the capital of a palatinate of the fame name, in the province of Lithuania in Poland: E. lon. 26°, N. lat. 56° 20′.

BRASS, or, as the French call it, *yellow copper*, is a factitious metal, made of copper and zinc, or lapis calaminaris. See CHEMISTRY, *Of zinc*

Corinthian BRASS has been famous in antiquity, and is a mixture of gold, silver, and copper. L. Mummius having sacked and burnt the city of Corinth, 146 years before Christ, it is said this metal was formed from the immense quantities of gold, silver and copper wherewith that city abounded, thus melted and run together by the violence of the conflagration.

BRASS-*colour*, one prepared by the braziers and colourmen to imitate brass. There are two sorts of it, the red brass, or bronze and the yellow or gilt brass: The latter is made only of copper-filings, the smallest and brightest that can be found; with the former they mix some red ochre, finely pulverized; they are both used with varnish.

BRASSE, in ichthyology, the English name of the perca lucioperca. See PERCA.

BRASSICA, or CABBAGE, in botany, a genus of the tetradynamia siliquosa class. The calix is erect and connivent; the seeds are globular; and there is a nectariferous gland between the pistillum and the short stamina, and between the calix and the long stamina. There are ten species of this plant, most of which are excellent pot-herbs, and cultivated in our gardens.

BRASSICAVIT, or BRACHICAVIT, in the menage, is a horse whose fore-legs are naturally bended archwise: being so called by way of distinction from an arched horse, whose legs are bowed by hard labour.

BRAVA, or *Pareira*-BRAVA. See PAREIRA *Brava*.

BRAULS, Indian cloths with blue and white stripes. They are otherwise called turbants, because they serve to cover those ornaments of the head, particularly on the coast of Africa.

BRAUNAU, or BRANAU, a town of Bavaria in Germany, about twenty-five miles south-west of Passau.

BRAUNSBURG, a town of Prussia, situated on the Baltic sea, about thirty miles south-west of Koningsburg: E. long. 20°, N. lat. 54° 15′.

BRAVO, one of the Cape verd islands: W. long. 25°, N lat. 14°.

BRAURONIA, in Grecian antiquity, a festival in honour of Diana, surnamed *Brauronia*, from its having been observed at Brauron, an Athenian borough.

This festival was celebrated once in five years, being managed by ten men, called, in Greek, [*ieropoioi*]. The victim offered in sacrifice was a goat, and it was customary for certain men to sing one of Homer's iliads. The most remarkable persons at this solemnity were young virgins, habited in yellow gowns, and consecrated to Diana. It was unlawful for any of them to be above ten, or under five years of age.

BRAWN, the flesh of a boar souced or pickled; for which end the boar should be old; because the older he is, the more horny will the brawn be.

The method of preparing brawn is as follows: The boar being killed, it is the flitches only, without the legs, that are made brawn; the bones of which are to be taken out, and then the flesh sprinkled with salt, and laid in a tray, that the blood may drain off: Then it is to be salted a little, and rolled up as hard as possible. The length of the collar of brawn, should be as much as one side of the boar will bear; so that when rolled up, it will be nine or ten inches diameter.

The collar being thus rolled up, is to be boiled in a copper, or large kettle, till it is so tender, that you can run a straw through it; then set it by, till it is thorough cold, and put it into the following pickle. To every gallon of water, put a handful or two of salt, and as much wheat bran: Boil them together, then drain the bran as clear as you can from the liquor; and when the liquor is quite cold, put the brawn into it.

BRAY, a town of Champaign in France, about 16 miles north of Sens: E. long. 3° 20′, N. lat. 48° 25′.

BRAY is also the name of a port town of the county of Wicklow, and province of Leinster, in Ireland; W. long. 6° 16′, N. lat. 53° 12′.

BRAYLE, among sportsmen, a piece of leather slit to put upon the hawk's wing, to tie it up.

BRAZED, in heraldry, a term serving to describe three cheverons, one clasping another.

BRAZEN, something consisting of brass, or formed out of it. See BRASS.

BRAZIER, an artificer who makes or deals in all kinds of brass-ware.

BRAZIL. See BRASIL.

BRAZING, the soldering or joining two pieces of iron together by means of thin plates of brass, melted between the pieces that are to be joined. If the work be very fine, as when two leaves of a broken saw are to be brazed together, they cover it with pulverized borax, melted with water, that it may incorporate with the brass powder, which is added to it: The piece is then exposed to the fire without touching the coals, and heated till the brass is seen to run.

BRAZING is also the joining two pieces of iron together by beating them hot, the one upon the other, which is used for large pieces by farriers, *&c.*

BRAZZA, a town and island on the coast of Dalmatia, in the Gulph of Venice; E. long. 18°, N. lat. 43°.

BREACH, in fortification, a gape made in any part of the works of a town by the cannon or mines of the besiegers, in order to make an attack upon the place. To make the attack more difficult, the besieged sow the breach with crow-feet, or stop it with chevaux de frize.

A practicable breach, is that where the men may mount and make a lodgement, and ought to be fifteen or twenty fathoms wide. The besiegers make their way to it, by covering themselves with gabions, earth-bags, *&c.*

BREACH, in a legal sense, is where a person breaks through the condition of a bond or covenant; on an action upon which, the breach must be assigned: And this assignment must not be general, but particular; as, in an action of covenant for not repairing houses, it ought to be assigned particularly what is the want of reparation; and in such certain manner, that the defendant may take an issue.

BREAD,

BREAD, a mafs of dough, kneaded and baked in an oven. See BAKING.

Bread ought to be well kneaded, and feafoned with a little falt, otherwife it is accounted very unwholefome.

We find bread fometimes made of rye, oats, barley, or vetch-flour; but of all others, that prepared from wheat affords the moft wholefome nourifhment. In feveral parts of Afia, Africa, and America, they make bread of maiz-flour; befides which, the Americans make bread of the caffava-root. See CASSAVA.

Some are of opinion, that corn growing in gravelly and light lands, makes better bread than that which grows in deep and low grounds.

French-BREAD. To make good French bread, for every two quarts of flour, add fix fpoonfuls of ale yeaft; alfo milk and water, warmed; a bit of butter, and a little falt; make them pretty light, and letting them rife before the fire, bake them in a quick oven

Some put the yolks of fix eggs, and the whites of two, to this quantity; but others think the bread better without them.

Foreign bread, or bifket, pays duty on importation 1 s. $7\frac{15}{100}$d. for every 112 lb. whereof 1s. $5\frac{25}{100}$d. is repaid on exporting it again.

BREAD-ROOM, in a fhip, that deftined to hold the bread, or bifket.

The boards of the bread-room fhould be well joined and caulked, and even lined with tin plates, or mats. It is alfo proper to warm it well with charcoal, for feveral days before the bifket is put into it; fince nothing is more injuries to the bread than moifture.

BREAD, in fcripture ftyle, is taken for every fort of food. The ancient Hebrews had feveral ways of baking bread, as baking it under the afhes, between two fires made of cow-dung, and in an oven. The Jews had, befides their leavened and unleavened bread, their fhew-bread, bread of affliction, &c. See the articles LEAVENED, &c.

BREADTH, in geometry, one of the three dimenfions of bodies, which multiplied into their length conftitutes a furface.

BREAK, in a general fenfe, fignifies to divide a thing into feveral parts with violence.

In the art of war, to break ground, is to open the trenches before a place.

Among fportfmen, to break a horfe in trotting, is to make him light upon the hand in trotting, in order to make him fit for a gallop. To break a horfe for hunting, is to fupple him, to make him take the habit of running.

BREAKING, in a mercantile ftyle, denotes the not paying one's bills of exchange, accepted, or other promiffary notes, when due; and abfconding, to avoid the feverity of one's creditors. In which fenfe, breaking is the fame with becoming bankrupt. See BANKRUPT.

BREAKING BULK, in the fea language, is the fame with unlading part of the cargo.

BREAM, in ichthyology, the Englifh name of the cyprinus brama. See CYPRINUS.

BREAST, in anatomy, denotes the fore-parts of the thorax. See ANATOMY, p. 227.

BREASTS, or MAMMÆ, in anatomy. See ANATOMY, p. 227.

BREAST-PLATE, in antiquity, a piece of armour worn to defend the breaft, originally believed to be made of hides, or hemp twifted into fmall cords, but afterwards made of brafs, iron, or other metals, which were fometimes fo exquifitely hardened, as to be proof againft the greateft force.

BREAST-PLATE, in the menage, the ftrap of leather that runs from one fide of the faddle to the other, over the horfe's breaft, in order to keep the faddle tight, and hinder it from fliding backwards.

BREAST-PLOUGH, one fo fafhioned that a man may fhove it before him.

BREAST-WORK the fame with parapet. See PARAPET.

BREATH, the air infpired and expelled again in the action of refpiration.

BREATH, or WIND, in the menage, fometimes fignifies the eafy refpiration of an horfe, and fometimes it implies the eafe and reft or repofe of a horfe; as, give your horfe breath, that is, do not ride him down; give that leaping horfe a long breathing-time between the turns or repetitions of his menage, &c.

BREATHING, the fame with refpiration.

BRECHIN, a borough-town of the county of Angus in Scotland, about 15 miles north-eaft of Dundee; W. long. 2° 20′, north lat. 56° 40′.

BRECON, or BRECKNOCK, a borough-town of Brecknockfhire, in Wales; W. long. 3° 25′, N. lat. 52°.

BREDA, the capital of Dutch Brabant, about 30 miles north-eaft of Antwerp; E. long. 4° 40′, N. lat. 51° 40′. It is a ftrong fortified town.

BREECHES, a kind of clofe garment or covering for the thighs, hips, &c. worn by the modern Europeans.

The breeches are peculiar to the male fex, and anfwer, in fome meafure, to the femoralia of the Romans.

BREECH of a great gun, or cannon, the end next the touch-hole.

BREECHINGS, in the fea-language, the ropes with which the great guns are lafhed, or faftened to the fhip's fide.

They are thus called, becaufe made to pafs round the breech of the gun.

BREEDING, in a general fenfe, the producing, nourifhing, and educating all manner of young animals.

BREEDING *of horfes*. See EQUUS.

BREEZE, a fhifting wind, that blows from fea or land for fome certain hours in the day or night; common in Africa and fome parts of the E. and W. Indies.

The fea breeze is only fenfible near the coafts; it commonly rifes in the morning, about nine, proceeding flowly in a fine fmall black curl on the water, towards the fhore; it increafes gradually till twelve, and dies about five. Upon its ceafing, the land-breeze commences, which increafes till twelve at night, and is fucceeded in the morning by the fea-breeze again.

BREEZE, in brick-making, fmall afhes and cinders, fometimes made ufe of inftead of coals, for the burning of bricks: But as this does not fo well anfwer the end, the ufe of it is prohibited by 12 George I. cap. xxxv.

BREEZE,

BREEZE, is alſo the name of an inſect, called the gad-fly, or horſe-fly. See FLY.

BREGENTS, or BERGENTS, a town ſituated at the eaſt end of the lake of Conſtance, in the county of Tyrol in Germany; E. long. 9° 40′, and N. lat. 47° 26′.

BREGMA, in anatomy, the ſame with ſinciput. See ANATOMY, p. 154.

BREIDEWICK, a cape on the ſouth-weſt of Iceland, in the northern ocean.

BREMEN, the capital of the duchy of the ſame name, in Lower Saxony, ſituated on the river Weſer, in 8° 20′ E. long. and 53° 25′ N. lat.

This city and duchy belongs to the king of Great Britain, as elector of Hanover.

BREMERVHOIDE,, a fortified town of the duchy of Bremen, about ſeventeen miles north of Bremen; E. long. 8° 35′, and N. lat. 53° 48′.

BREMGARTEN, a town of Switzerland, in the county of Baden, about twelve miles weſt of Zurich; E. long. 8° 15′, and N. lat. 47° 20′.

BREMINGHAM, in geography. See BIRMINGHAM.

BRENBERG, in geography. See BERNBURG.

BRENT, in geography, a market town of Devonſhire, ſituated twenty-ſeven miles ſouth-weſt of Exeter; W. long. 4° 7′, and N. lat. 50° 30′.

BRENT-*gooſe*, a ſpecies of gooſe with a black neck, and a white collar round; uſually confounded with the barnacle, though in reality a diſtinct ſpecies.

It is a little larger than the common duck, and is deſcribed by authors under the name of *anas torquata*.

BRENTA, a liquid meaſure uſed at Rome.

BRENTE, in geography, a river which, taking its riſe in the biſhopric of Trent, in Germany, runs ſouth-eaſt through the Venetian territories, and falls into the Adriatic ſea, oppoſite to Venice.

BRENTFORD, a market-town of Middleſex, about ſeven miles weſt of London; W. long. 7′, and N. lat 51° 26′.

BRENTWOOD, or BURNTWOOD, a market town of Eſſex, about fifteen miles eaſt of London; E. long. 15′, and N. lat. 51° 35′.

BREPHOTROPHIUM, an hoſpital for the maintenance of children; not unlike our foundling-hoſpital. See HOSPITAL.

BRESCIA, a city of Italy, about thirty miles north of Cremona; E. long. 10° 35′, and N. lat. 45° 30′.

It is a biſhop's ſee, and ſubject to Venice.

BRESELLO, a town of the duchy of Modena, in Italy, ſituated on the ſouthern ſhore of the river Po, about twenty five miles north-weſt of Modena; E. long. 11°, and N. lat. 44° 46′.

BRESICATE, in commerce, a kind of bays, of which there is ſome trade carried on with the negroes, between the river Gambia and Sierra Leone. The beſt ſorts for that purpoſe are the blue and the red.

BRESLAW, the capital of Sileſia, ſituated upon the river Oder, in 16° 50′ E. long. and 51° 15′ N lat.

BRESMA, in ichthyology, a name uſed by ſome for the bream. See BREAM.

BRESSE, a territory of Burgundy, in France; it is bounded by Franche Compte on the north, by Savoy on the eaſt, by Dauphine on the ſouth, and by the Lyonois on the weſt.

BRESSICI, in geography. See BRESTE.

BRESSVIRE, a town of Poictou, in the Orleanois, in France, ſituated about thirty-five miles north-weſt of Poictiers; W. long. 30′, and N. lat. 46° 50′.

BREST, in geography, an excellent port-town of Britany in France; W. long. 4° 30′, and N. lat. 48° 25′.

BREST, or BREAST, in architecture, a term ſometimes uſed for the member of a column, more uſually called *torus*. See TORUS.

BREST-*ſummers*, in timber buildings, are pieces in the outward thereof, into which the girders are framed: this, in the ground-floor, is called a cell; and, in the garret-floor, a beam.

As to their ſize, it is the ſame with that of girders. See GIRDERS.

BRESTE, or BRESSICI, the capital of the palatinate of Breſſici, and of Poleſia, in Poland, ſituated on the river Bog, about eighty miles eaſt of Warſaw; E. long. 24°, and N. lat. 52°.

BRETESSE, in heraldry, denotes a line embattled on both ſides.

BRETON, or CAPE-BRETON, an American iſland, ſubject to the Engliſh, and ſeparated from New-Scotland by a narrow ſtreight called Canſo: it is about one hundred miles in length, and fifty in breadth, and is ſituated between 61° and 62° W. long. and between 45° and 48° N. lat.

BRETVEIL, a town of Normandy, in France, about thirty-five miles ſouth of Rouen; E. long. 1°, and lat. 48° 50′.

BRETVEIL is alſo the name of a town in Picardy, about ſix leagues from Amiens.

BREUBERG, a country and town of Germany, in the circle of Franconia, ſituated upon the banks of the Maine.

BREVE, in law, is any writ directed to the chancellor, judges, ſheriffs, or other officers, whereby a perſon is ſummoned, or attached, to anſwer in the king's court, *&c.*

BREVE *perquirere*, the purchaſing of a writ or licence for trial in the king's courts; whence comes the preſent uſage of paying 6 s. 8 d. fine to the king in ſuit, for money due on bond, where the debt is 40 l. and of 10 s. where it is 100 l. *&c.*

BREVE *de recto* is a writ of right, or licence, for a perſon ejected, to ſue for the poſſeſſion of the eſtate detained from him.

BREVE, in muſic, a note or character of time, in the form of a diamond or ſquare, without any tail, and equivalent to two meaſures or minims.

BREVET, in the French cuſtoms, denotes the grant of ſome favour or donation from the king, in which ſenſe it partly anſwers to our warrant, and partly to letters-patent.

BREVIARY, a daily office, or book of divine ſervice, in the Romiſh church. It is compoſed of matins, lauds, firſt, third, ſixth, and ninth veſpers, and the compline, or poſt communio.

The

The breviary of Rome is general, and may be ufed in all places; but on the model of this various others have been built, appropriated to each diocefe, and each order of religious.

The breviary of the Greeks is the fame in almoft all churches and monafteries that follow the Greek rites: the Greeks divide the pfalter into twenty parts. In general, the Greek breviary confifts of two parts; the one containing the office for the evening, the other that of the morning, divided into matins, lauds, firft, third, fixth, and ninth vefpers, and the compline; that is, of feven different hours, on account of that faying of David, *Septies in die laudem dixi tibi.*

The inftitution of the breviary is not very ancient: there have been inferted in it the lives of the faints, full of ridiculous and ill-attefted ftories, which gave occafion to feveral reformations of it, by feveral councils, particularly thofe of Trent and Cologn; by feveral popes, particularly Pius V. Clement VIII. and Urban VIII.; and alfo by feveral cardinals and bifhops, each lopping off fome extravagances, and bringing it nearer to the fimplicity of the primitive offices. Originally, every body was obliged to recite the breviary every day; but by degrees the obligation was reduced to the clergy only, who are enjoined, under penalty of mortal fin and ecclefiaftical cenfures, to recite it at home, when they cannot attend in public. In the XIVth century, there was a particular referve granted in favour of bifhops, who were allowed, on extraordinary occafions, to pafs three days without rehearfing the breviary.

This office was originally called *curfus*, and afterwards the *breviarium*; which latter name imports, that the old office was abridged, or rather, that this collection is a kind of abridgment of all the prayers.

The breviaries now in ufe are innumerable; the difference between them confifts principally in the number and order of the pfalms, hymns, pater-nofters, ave-Maries, creeds, magnificats, cantemus's, benedictus's, canticamus's, nunc dimittis's, miferere's, halelujah's, gloria patri's, *&c.*

Breviary, in Roman antiquity, a book firft introduced by Auguftus, containing an account of the application of the public money.

BREVIATOR, an officer under the eaftern empire, whofe bufinefs it was to write and tranflate briefs.

At Rome thofe are ftill called breviators, or abbreviators, who dictate and draw up the pope's briefs.

BREVIBUS *a rotulis liberandis*, a writ or command to a fheriff to deliver to his fucceffor the county, with the appurtenances, and the rolls, writs, and other things to his office belonging.

BREVIER, among printers, a fmall kind of type or letter between bourgeois and minion.

BREVIUM *cuftos*, See Custos.

BREVORDT, a town of Guelderland, in the United Netherlands, fituated about twenty-five miles fouth-eaft of Zutphen, in 6° 35′ E. long. and 52° N. lat.

BREWER, a perfon who profeffes the art of brewing.

There are companies of brewers in moft capital cities; that of London was incorporated in 1427, by Hen. VI. and that of Paris is ftill older.

Brewer's-haven, a good harbour at the north end of the ifland of Chiloe, on the coaft of Chili, in South America; W. long. 82°, and S. lat. 42°.

BREW HOUSE, a place for brewing. See Brewing.

B R E W I N G.

BREWING is the operation of preparing ale or beer from malt. Before we treat of this operation, it will be neceffary to explain the nature of malt, and the method of making it.

OF MALT.

That fpecies of fermentation which is called the *vinous fermentation*, is only produceable by the juices of vegetable fubftances. The fugar or faccharine matter is the caufe of this fermentation. If fugar be added to water in the proportion of 1 to 3, a proper vinous fermentation is excited. When this faccharine matter is extracted from vegetables, they immediately lofe their fermentative power. Moft plants either naturally contain this faccharine matter, or are capable of acquiring it by a certain method of treatment. This procefs of converting vegetable fubftances into a fugar is known by the name of *malting*.

Though moft vegetable fubftances be convertible into malt, barley is found by experience to be the moft proper for undergoing this operation.

As the converting of grains into malt, is only a part of the progrefs towards their germination, it may be performed by committing them for fome time to the earth. But the ordinary method is to fteep the barley for fome time in water, and then to expofe it in heaps on the floor of a barn till it begins to heat: after which, it muft be fpread out in thin layers, to prevent putrefaction. It ought to continue in this fituation till the plume or bud is juft about to efcape from the feed, and then it is confidered as perfectly malted; that is, the feeds are converted into a fweet, moift fubftance. This change of tafte, or malting, keeps exact pace with the progrefs of the plume; hence one half of the feed is frequently malted, while the other undergoes no change. If the plume be allowed to fhoot fully out, the feeds immediately lofe their faccharine tafte, and are changed into infipid hollow

hollow bags. When seeds are thus sufficiently malted, they must be dried in malt-kilns, the fuel of which should smoke as little as possible.—The husks must now be broke open by malt-milns, and then infused or mashed in warm water, in order to extract the saccharine substance; the heat applied should be very slow and gradual. Thus the malt is dissolved, and lies till the liquor be sufficiently tinctured. When the malt is too long diffused, so that an acetous fermentation begins to take place, it is called *blinking*, or *foxing*, by brewers.

This tincture obtained from the infusion of grinded malt, is commonly known by the name of *wort*.

We shall now give an account of this process in the language and manner of the actual brewer, which will probably be more acceptable than treating it in a philosophical manner.

Of making Malt.

The barley must be put into a leaden or tiled cistern, that holds five, ten, or more quarters, and covered with water four or six inches above the barley, to allow for its swell. Here it must lie five or six tides, as the maltster calls it, reckoning twelve hours to the tide, according as the barley is in body or in driness. The way to know when it is enough, is to take a corn, end-ways, between the fingers, and gently crush it; and if it be in all parts mellow, and the husk opens, or starts a little from the body of the corn, then it is enough. The nicety of this is a material point; for if it be infused too much, the sweetness of the malt will be greatly taken off, and yield the less spirit, and will cause deadness and sourness in ale or beer in a short time, for the goodness of the malt contributes much to the preservation of all ales and beers. Then the water must be well drained from it, and it will come equal and better on the floor, which may be done in twelve or sixteen hours in temperate weather, but in cold near thirty. From the cistern, it is put into a square hutch or couch, where it must lie thirty hours; then it must be worked night and day in one or two heaps, as the weather is cold or hot, and turned every four, six, or eight hours, the outward part inwards, and the bottom upwards, always keeping a clear floor, that the corn that lies next to it be not chilled; and as soon as it begins to come or spire, then turn it every three, four, or five hours, as was done before, according to the temper of the air, which greatly governs this management; and as it comes or works more, so must the heap be spreaded and thinned larger to cool it. Thus it may lie and be worked on the floor in several parallels, two or three feet thick, ten or more feet broad, and fourteen or more in length, to chip or spire, but not too much nor too fast; and when it is come enough, it is to be turned twelve or sixteen times in twenty four hours, if the season is warm, as in March, April, or May; and when it is fixed, and the root begins to be dead, then it must be thickened again, and carefully kept often turned and worked, that the growing of the root may not revive, and this is better done with the shoes off than on: And here the workman's art and diligence in particular is tried, in keeping the floor clear, and turning the malt often, that it neither moulds nor acre-spires, that is, that the blade does not grow out at the opposite end of the root; for, if it does, the flower and strength of the malt is gone, and nothing left behind but the acre-spire, husk, and tail: Now, when it is at this degree, and fit for the kiln, it is often put into a heap, and let lie twelve hours before it is turned, to heat and mellow, which will much improve the malt if it is done with moderation, and after that time it must be turned every six hours during twenty-four; but if it is overheated, it will become like grease and be spoiled, or at least cause the drink to be unwholesome. When this operation is over, it then must be put on the kiln, to dry four, six, or twelve hours, according to the nature of the malt; for the pale sort requires more leisure, and less fire, than the amber or brown sorts: Three inches thick was formerly thought a sufficient depth for the malt to lie on the hair-cloth; but now six is often allowed it; fourteen or sixteen feet square will dry about two quarters, if the malt lies four inches thick, and here it should be turned every two, three, or four hours, keeping the hair cloth clear: The time of preparing it from the cistern to the kiln is uncertain, according to the season of the year; in moderate weather, three weeks are often sufficient. When the malt is dried, it must not cool on the kiln, but be directly thrown off, not into a heap, but spreaded wide in an airy place, till it is thoroughly cool; then put it into a heap, or otherwise dispose of it.

There are several methods used in drying of malts, as the iron-plate frame, the tile-frame, that are both full of little holes; the brass-wired, and iron-wired frame, and the hair-cloth. The iron and tiled ones were chiefly invented for drying of brown malts, and saving of fuel; for these, when they come to be thorough hot, will make the corns crack and jump by the fierceness of their heat, so that they will be roasted or scorched in a little time; and after they are off the kiln, to plump the body of the corn, and make it take the eye, some will sprinkle water over it, that it may meet with the better market: But if such malt is not used quickly, it will slacken and lose its spirits to a great degree, and perhaps, in half a year or less, may be taken by the whools and spoiled. Such hasty dryings, or scorchings, are also apt to bitter the malt, by burning its skin, and therefore these kilns are not so much used now as formerly. The wire-frames indeed are something better, yet they are apt to scorch the outward part of the corn, that cannot be got off so soon as the hair-cloth admits of, for these must be swept when the other is only turned at once; however, these last three ways are now in much request for drying pale and amber malts, because their fire may be kept with more leisure, and the malt more gradually and better dryed. But by many the hair cloth is reckoned the best.

Malts are dried with several sorts of fuel; as the coak, Welch coal, straw, wood, and fern, *&c.* But the coak is reckoned by most to exceed all others for making drink of the finest flavour and pale colour, because it sends no smoke forth to hurt the malt with any offensive tang, that wood, fern, and straw are apt to do in

in a leſſer or greater degree; but there is a difference even in what is called coak, the right ſort being large pit-coal charred or burnt in ſome meaſure to a cinder, till all the ſulphur is conſumed and evaporated, which is called choak; and this, when it is truly made, is the beſt of all other fuels. But if there be but one cinder as big as an egg, not thoroughly cured, the ſmoke of this one is capable of doing damage, which happens too often by the negligence or avarice of the choak-maker: There is another ſort, by ſome wrongly called choak, and rightly named culm or Welch-coal, from Swanzey in Pembrokeſhire, being of a hard ſtony ſubſtance, in ſmall bits, reſembling a ſhinning coal, and will burn without ſmoke, and by its ſulphureous effluvia caſt a moſt excellent whiteneſs on all the outward parts of the grainy body: In Devonſhire their marble or grey fire-ſtone is burnt into lime with the ſtrong fire that this culm makes, and both this and the chalked pit-coal afford a moderate and certain fire to all malt that is dried by it. Straw is the next ſweeteſt fuel; but wood and fern are the worſt.

Some put a peck or more of peaſe, and malt them with five quarters of barley, to mellow the drink: Beans are uſed for the ſame purpoſe; but they do not come ſo ſoon, nor mix ſo conveniently with the malt, as the pea.

Barley is not fit to make malt of till it is fully mellowed and ſweated in the mow, and the ſeaſon of the year is ready for it, without both which there can be no aſſurance of good malt. This untimely making of malt often occaſions bad ales and beers; for ſuch malt retaining ſome of its barley nature, or that the ſeaſon of the year is not cold enough to admit of its natural working on the floor, is not capable of producing a true malt, but will cauſe its drink to ſtink in the caſk inſtead of growing fit for uſe, as not having its genuine malt nature to cure and preſerve it, which all good malts contribute to as well as the hop.

Mellilet, a moſt ſtinking weed that grows among barley, if not thoroughly cleaned from it before malting, makes the drink ſo heady, that it is apt to intoxicate the unwary by drinking a ſmall quantity: Beſides, it gives a nauſeous flavour to the liquor.

To know good from bad Malts.

First, break the malt-corn acroſs between the teeth, in the middle, or at both ends, and if it taſteth mellow and ſweet, has a round body, breaks ſoft, is full of flour all its length, ſmells well, and has a thin ſkin, then it is good Secondly, take a glaſs near full of water, and put in ſome malt; if it ſwims, it is right; but if any ſinks to the bottom, then it is not true malt, but ſteely, and retains ſomewhat of its barley nature; this, however, is not an infallible rule, becauſe, if a corn of malt is cracked, ſplit, or broke, it will then take the water and ſink; but an allowance may be given for ſuch incidents, and ſtill room enough to make a judgment. Thirdly, malt that is truly made will not be hard and ſteely, but of ſo mellow a nature, that, if forced againſt a dry board, it will mark, and caſt a white colour almoſt like chalk. Fourthly, malt that is not rightly made will be part of it of a hard barley nature, and weigh heavier than that which is true malt.

Of the Nature and Uſe of Pale, Amber, and Brown Malts.

The pale malt is the ſloweſt and ſlackeſt dried of any, and where it has had a leiſure fire, a ſufficient time allowed it on the kiln, and a due care taken of it, the flour of the grain will remain in its full quantity, and thereby produce a greater length of wort than the brown high-dried malt. It may be brewed either with ſpring or common well water.

The amber-coloured malt is that which is dried in a medium degree, between the pale and the brown, and is very much in uſe, as being free of either extreme. Its colour is pleaſant, its taſte agreeable, and its nature wholeſome, which makes it be preferred by many as the beſt of malts; this by ſome is brewed either with hard or ſoft waters, or a mixture of both.

The brown malt is the ſooneſt and higheſt dried of any, even till it is ſo hard, that it is difficult to bite ſome of its corns aſunder. This malt, by ſome, is thought to occaſion the gravel or ſtone, and is by its ſteely nature leſs nouriſhing than the pale or amber malts, being very much impregnated with the fiery particles of the kiln, and therefore its drink ſooner becomes ſharp and acid than that made from the pale or amber ſorts, if they are all fairly brewed: For this reaſon the London brewers moſtly uſe the Thames or New River waters to brew this malt with, for the ſake of its ſoft nature, whereby it agrees with the harſh qualities of it better than any of the well or other hard ſorts, and makes a luſcious ale for a little while, and a but-beer, or porter, that will keep very well five or ſix months; but after that time it generally grows ſtale, notwithſtanding there be ten or twelve buſhels allowed to the hogſhead, and it be hopped accordingly.

Pale and amber malts dried with coak or culm, obtain a more clean, bright, pale colour, than if dried with any other fuel, becauſe there is not ſmoak to darken and ſully their ſkins or huſks, and give them an ill reliſh, which thoſe malts have, more or leſs, that are dried with ſtraw, wood, or fern, *&c.* The coak or Welch coal alſo makes more true and compleat malt than any other fuel, becauſe its fire gives both a gentle and certain heat, whereby the corns are in all their parts gradually dried; and therefore of late theſe malts have gained ſuch a reputation, that great quantities have been conſumed in moſt parts of the nation for their wholeſome nature and ſweet fine taſte.

Next to the coak-dried malt, the ſtraw dried is the ſweeteſt and beſt taſted: This, it muſt be acknowledged, is ſometimes well malted, where the barley, wheat, ſtraw, conveniencies, and the maker's ſkill, are good; but as the fire of the ſtraw is not ſo regular as the coak, the malt is attended with more uncertainty in its making, becauſe it is difficult to keep it to a moderate and equal heat, and alſo expoſes the malt in ſome degree to the taſte of the ſmoak.

Brown malts are dried with ſtraw, wood, and fern, *&c.*

&c. the ſtraw-dried is the beſt; the wood-ſort has a moſt ungrateful taſte, and few can bear it, but the neceſſitous, and thoſe that are accuſtomed to its ſtrong ſmoaky tang; yet it is much uſed in ſome of the weſtern parts of England.

The fern-dried malt is alſo attended with a rank diſagreeable taſte from the ſmoak of this vegetable.

Of grinding Malts.

THIS article well deſerves the notice of all brewers, for on it the goodneſs of our drink greatly depends; becauſe, if it is ground too ſmall, the flour of the malt will be the eaſier and more freely mixed with the water, and will cauſe the wort to run thick; therefore the malt muſt be only juſt broke in the mill, to make it emit its ſpirit gradually, and incorporate its flour with the water in ſuch a manner, that firſt a ſtout beer, then an ale, and afterwards a ſmall beer may be had at one and the ſame brewing, and the wort run off fine and clear to the laſt. Many are likewiſe ſo ſagacious as to grind their brown malt a fortnight before they uſe it, and keep it in a dry place, that it may become mellower, by loſing in a great meaſure the fury of its harſh fiery particles, and its ſteely nature, which this ſort of malt acquires on the kiln. However, this, as well as many other hard bodies, may be reduced by time and air into a more ſoluble, mellow, and ſoft condition, and then it will imbibe the water, and give a natural kind tincture more freely, by which a greater quantity and ſtronger drink may be made than if it was uſed directly from the mill, and be much ſmoother and better taſted. But pale malts will be fit for uſe at a week's end, becauſe the leiſureneſs of their drying endows them with a ſoftneſs from the time they are taken off the kiln to the time they are brewed, and ſupplies in them what time and air muſt do in the brown ſorts. This method of grinding malt ſo long beforehand cannot be ſo conveniently practiſed by ſome of the great brewers, becauſe ſeveral of them brew two or three times a week; but now moſt of them grind their malts into the tun by the help of a long, deſcending, wooden ſpout; and here they ſave the charge of emptying or uncaſing it out of the bin, and alſo the waſte of a great deal of the malt-flour, that is loſt when carried in baſkets. A ſteel hand-mill, will, by the help of only one man, grind ſix or eight buſhels in an hour, and will laſt a family many years without hardening or cutting. There are ſome old faſhioned ſtone hand-mills in being, that ſome prefer to the iron ones, becauſe they alledge that theſe break the corn's body, when the iron ones only cut it in two, which occaſions the malt, ſo broke by the ſtones, to give the water a more eaſy, free, and regular power to extract its virtue, than the cut-malt can that is more confined within its hull. Notwithſtanding, the iron ones are now moſtly in uſe, for their great diſpatch and long duration. In the country they frequently throw a ſack of malt on a ſtone or brick floor as ſoon as it is ground, and let it lie, giving it one turn, for a day or two, that the ſtones or bricks may draw out the fiery quality it received from the kiln, and give the drink a ſoft mild taſte.

Of the Nature of ſeveral Waters, and their Uſe in Brewing.

WATER is a matter of great importance in brewing wholeſome fine malt-liquors. Now, the more ſimple and freer every water is from foreign particles, it is the better.

Spring-waters are in general liable to partake of thoſe minerals through which they paſs. At Uppingham in Rutland, their water is ſaid to come off an alum rock, and ſo tinges their beer with its ſaline quality, that it is eaſily taſted at the firſt draught. But that which will lather with ſoap, or ſoft water, that percolates through chalk, or a grey fire-ſtone, is generally accounted beſt; for chalk in this reſpect excells all other earths, becauſe it communicates nothing unwholeſome to the waters, but abſorbs any minerals that may accompany the water that runs through them: For which reaſon they throw in great quantities of chalk into their wells at Aileſbury to ſoften their water, which, coming off a black ſandſtone, is ſo hard and ſharp, that it will often turn their beer ſour in a week's time; ſo that in its original ſtate it is neither fit to waſh nor brew with, but ſo long as the alcaline particles of the chalk hold good, they put it to both uſes.

River-water is leſs liable to be loaded with metallic, petrifying, or ſaline particles, than the well or ſpring ſorts, eſpecially at ſome diſtance from the ſpring head, becauſe the rain-water mixes with and ſoftens it. But in running, it often collects groſs particles, from ouzy muddy mixtures, particularly near town, which make the beer ſubject to new fermentations, and grow foul upon any alteration of the weather, as the Thames-water generally does; yet this, for its ſoftneſs, is much better than the hard ſort; however, both theſe waters are uſed by ſome brewers. But where river-water can be had clean in a dry time, when no great rain has lately fell out of rivulets, or rivers that have a gravelly, chalky, ſandy, or ſtony bottom, free from the diſturbance of cattle, *&c.* and in good air, it may then juſtly claim the name of a moſt excellent water for brewing, and will make a ſtronger drink with the ſame quantity of malt than any of the well-waters; inſomuch that that of the Thames has been proved to make as ſtrong beer with ſeven buſhels of malt, as well-water with eight; and ſo are all river-waters in a proportionable degree, and, where they can be obtained clean and pure, drink may be drawn fine in a few days after tunning.

Rain-water is very ſoft, of a moſt ſimple and pure nature, and the beſt diluter of any, eſpecially if received free from dirt and mortar that often mix with it as it runs off tiled roofs; this is very agreeable for brewing of ales that are not to be kept long, but for beers that are to remain ſome time in the caſks, it is not ſo good, being apt to putrify the ſooneſt of any.

Pond waters. This includes all ſtanding waters, chiefly from rain, and are good or bad according to circumſtances; for where there is a clean bottom, and the water lies undiſturbed from the tread of cattle, or too many fiſh, in an open ſound air, in a large quantity, and where

where the ſun has free acceſs, it is then nearly as good as rain or river-waters. But where it is in a ſmall quantity, or full of fiſh (eſpecially the fling-tench) or is ſo diſturbed by cattle, as to force up mud and filth, it is then the moſt foul and diſagreeable of all others: So is it likewiſe in long dry ſeaſons, when our pond-waters are ſo low as to oblige us to ſtrain it through ſieves before we can uſe it, to take out the ſmall red worms and other corruptions that ſtagnant waters are ſubject to.

The London Method of Brewing.

Stout Butt-beer or Porter.

THIS is the ſtrongeſt porter that is brewed from brown malt, and often ſold for forty ſhillings the barrel, or ſix pounds the butt out of the wholeſale cellars: The liquor (for it is ſix-pence forfeit in the London brew-houſe if the word *water* is named) in the copper deſigned for the firſt maſh, has a two-buſhel baſket, or more, of the moſt hully malt thrown over it, to cover its top, and afterwards its boiling; this muſt be made very hot, almoſt ready to boil, yet not ſo as to bliſter, for then it will be in too high heat; but, as an indication of this, the foul part of the liquor will aſcend, and the malt ſwell up, and then it muſt be parted, looked into, and felt with the finger or back of the hand, and if the liquor be clear, and of ſuch heat as can be but juſt endured, it is then enough, and the ſtoker muſt damp his fire as ſoon as poſſible, by throwing in a good parcel of freſh coals, and ſhutting his iron vent-doors; immediately on this, they let as much cold liquor or water run into the copper as will make it all of a heat, ſomewhat more than blood-warm; this they pump over, or let it paſs by a cock into an upright wooden ſquare ſpout or trunk, and it directly riſes through the holes of a falſe bottom into the malt, which is worked by ſeveral men with oars for about half an hour, and is called the firſt and ſtiff maſh: While this is doing, there is more liquor heating in the copper, that muſt not be let into the maſh-tun till it is very ſharp, almoſt ready to boil; with this they maſh again, then cover it with ſeveral baſkets of malt, and let it ſtand an hour before it runs into the under-back, which, when boiled an hour and a half with a good quantity of hops, makes this ſtout. The next is maſhed with a cooler liquor, then a ſharper, and the next blood-warm or quite cold; by which alternate degrees of heat, a quantity of ſmall beer is made after the ſtout.

To make Porter, or Butt-beer, to have a fine Tang.

THIS, of late, has been improved two ways: Firſt, by mixing two buſhels of pale malt with ſix of brown, which will preſerve butt-beer in a mellow condition, and cauſe it to have a pleaſant ſweet flavour: And, ſecondly, further to improve and render it more palatable, they boil it two hours and a half, and work it two days as cold as poſſible in the tun; at laſt, they ſtir it, and put a good handful of common ſalt into the quantity of a butt: Then, when the yeaſt has had one riſing more, they tun it.

Strong Brown Ale, called Stitch.

MOST of this is the firſt running of the malt, but yet of a longer length than is drawn from the ſtout; it has but few hops boiled in it, and is ſold for eight-pence *per* gallon at the brew-houſe out of the tun, and is generally made to amend the common brown ale with, on particular occaſions.

Common Brown Ale and Starting-beer.

THEY take the liquors from the brown ale as for the ſtout, but draw a greater quantity from the malt than for ſtout or ſtitch; and after the ſtiff and ſecond maſh, they cap the goods with freſh malt, to keep in the ſpirit, and boil it an hour; after this, ſmall beer is made of the ſame goods. Thus alſo the common brown ſtarting butt-beer or porter is brewed, only boiled with more hops an hour and a half, and worked cooler and longer than the brown ale, and a ſhorter length drawn from the malt. But it is cuſtomary after the brown ale, or when a quantity of ſmall beer is wanted, or is to be brewed better than ordinary, to put ſo much freſh malt on the goods as will anſwer that purpoſe.

Pale and Amber Ales and Beer.

AS the brown malts are brewed with river, theſe are brewed with well or ſpring-liquors. The liquors are by ſome taken ſharper for pale than brown malts, and, after the firſt ſcalding liquor is put over, ſome lower the reſt by degrees, to the laſt, which is quite cold, for their ſmall beer; and for butt-beers, there is no other difference than the addition of more hops, and boiling, and the method of working.

Entire Guile Small Beer.

ON the firſt liquor they throw ſome hully malt, to ſhew the break of it, and when it is very ſharp, they let in ſome cold liquor, and run it into the tun milk-warm; this is maſhed with thirty or forty pulls of the oar, and let ſtand till the ſecond liquor is ready, which muſt be almoſt ſcalding hot to the back of the hand; then run it by the cock into the tun, maſh it up, and let it ſtand an hour before it is ſpent off into the under-back: Theſe two pieces of liquor will make one copper of the firſt wort, without putting any freſh malt on the goods; the next liquor to be blood-warm, the next ſharp, and the next cool or cold; for the general way in great brew-houſes is, to let a cool liquor precede a ſharp one, becauſe it gradually opens the pores of the malt and goods, and prepares the way for the hotter liquor that is to follow.

The ſeveral Lengths or Quantities of Drinks that have been made from Malt, and their ſeveral Prices, as they have been ſold at a common Brew-houſe.

FOR ſtout-beer, is commonly drawn one barrel off a quarter of malt, and ſold for thirty ſhillings *per* barrel from the tun. For ſtitch or ſtrong brown ale, one barrel and a firkin, at one and twenty ſhillings and four pence *per* barrel from the tun. For common brown ale, one barrel and a half, or more, at ſixteen ſhillings *per* barrel, that holds thirty-two Engliſh gallons from the tun. For entire ſmall beer, five or ſix barrels off a quarter, at ſeven or eight ſhillings *per* barrel from the tun. For pale and amber ale, one barrel and a firkin, at one ſhilling *per* gallon, from the tun.

A Method practised by a Victualler, for Brewing Ale or October Beer, from Nottingham.

His copper holds twenty-four gallons, and the mash-tub has room enough for four or more bushels of malt. The first full copper of boiling water he puts into the mash-tub, there to lie a quarter of an hour, till the steam is so far spent that he can see his face in it; or, as soon as the hot water is put in, throws a pail or two of cold water into it, which will bring it at once into a temper; then he lets three bushels of malt be run leisurely into it, and stirred or mashed all the while, but as little as can be, or no more than just to keep the malt from clotting or balling; when that is done, he puts one bushel of dry malt at the top, to keep in the vapour or spirit, and so lets it stand covered two hours, or till the next copper-full of water is boiling hot, which he lades over the malt or goods three hand-bowls full at a time, that are to run off at the cock or tap by a very small stream before more is put on, which again must be returned into the mash tub till it comes off exceeding fine; for, unless the wort is clear when it goes into the copper, there are little hopes it will be so in the barrel; which leisure way obliges him to be sixteen hours in brewing these four bushels of malt. Now between the ladings-over he puts cold warer into the copper to be boiling hot, while the other is running off; by this means his copper is kept up near full, and the cock spending to the end of brewing his ale or small beer, of which only twenty-one gallons must be saved of the first wort that is reserved in a tub, wherein four ounces of hops are put, and then it is to be set by. For the second wort we will suppose there are twenty gallons of water in the copper boiling hot, that must be all laded over in the same manner as the former was, but no cold water need here be mixed; when half of this is run out into a tub, it must be directly put into the copper with half of the first wort, strained through the brewing-sieve as it lies on a small wooden loose frame over the copper, to keep back those hops that were first put in to preserve it, which is to make the first copper twenty-one gallons; then, upon its beginning to boil, he puts in a pound of hops in one or two canvas or other coarse linen bags, somewhat larger than will just contain the hops, that an allowance may be given for their swell; this he boils away very briskly for half an hour, when he takes the hops out and continues boiling the wort by itself till it breaks into particles a little ragged, and then it is enough, and must be dispersed into the cooling-tubs very thin: Then put the remainder of the first and second wort together, and boil that the same time, in the same manner, and with the same quantity of fresh hops, as the first was. The rest of the third or small-beer wort will be about fifteen or twenty gallons more or less, which he mixes directly with some cold water to keep it free of excise, and puts it into the copper as the first liquor to begin a second brewing of ale, with another four bushels of malt as he did before, and so on for several days together if necessary; and at last there may be some small-beer made.

The Nature and Use of the Hop.

This vegetable was formerly thought to be an unwholesome ingredient. Indeed, when the hop, in a dear time, is adulterated with water, in which aloes, &c. have been infused, in order to make the old hops recover their bitterness, and seem new, then they are to be looked on as unwholesome; but the pure new hop, when properly managed, has no hurtful qualities. But if the hops are boiled in strong or small worts beyond their fine and pure nature, the liquor suffers, and will be tanged with a noxious taste, both ungrateful and unwholesome to the stomach; and, if boiled to a very great excess, they will be apt to cause reachings. It is for these reasons that we advise the boiling two parcels of fresh hops in each copper of ale-wort; and, if there were three for keeping beer, it would be so much the better for the taste, health of body, and longer preservation of the beer in a sound smooth condition. For this purpose, some make a bag, like a pillowber, and boil the hops in it half an hour; then take them out, and put in another bag of the like quantity of fresh hops, and boil them half an hour more; by which means there is an opportunity of boiling both wort and hops a due time, saving the trouble of straining them through a sieve, and securing the seeds of the hops at the same time from mixing with the drink; afterwards they boil the same bags in the small beer, till the substance of it is got out; but observe that the bags be made larger than what would just contain the hops, otherwise it will be difficult to boil out their substance. It is true, that here is a charge increased by the consumption of a greater quantity of hops than usual; but then how greatly will they answer the desired end of enjoying fine-palated wholesome drink, that, in a cheap time, will not amount to much, if bought at the best hand; and, if we consider their after-use and benefit in small beer, there is not any loss at all in their quantity: But, where it can be afforded, the very small beer would be much improved if fresh hops were also shifted in the boiling of this as well as the stronger worts. Hence may appear the hardships that many are under of being necessitated to drink of those brewers malt-liquors, who, out of avarice, boil their hops to the last, that they may not lose any of their quintessence.

After the wort is cooled and put into the working-vat or tub, some throw fresh hops into it, and work them with the yeast, at the same time reserving a few gallons of raw wort to wash the yeast through a sieve to keep back the hop. This is a good way where enough of hops have not been sufficiently boiled in the wort, or to preserve it in the coolers where it is laid thick.

When hops are dear, many use the seeds of wormwood instead of them: Others use the daucus or wild-carrot seed that grows in our common fields, which many of the poor people gather and dry in their houses, for the purpose of selling them to the brewers: Others use horehound, which indeed is a fine bitter, and grows on several of our commons.

Hops have a fine grateful bitter, which makes the drink easy of digestion; they also keep it from running into such cohesions as would make it ropy, vapid, and sour; and therefore are not only of great use in boiled, but in raw worts, to preserve them sound till they can be put

put into the copper, and afterwards in the tun, while the drink is working.

Here then it muſt be obſerved, that the earthy part of the hop is the cauſe of that rough, harſh, unpleaſant taſte which accompany both ales and beers that have the hops ſo long boiled in them, as to tincture their worts with their miſchievous effects; for, notwithſtanding the malt be ever ſo good, the hops, if boiled too long in them, will be ſo predominant as to cauſe a bad taſte.

Of boiling Malt-liquors.

Although it has been formerly ſaid, that an hour and a half is requiſite for boiling of October beer, and an hour for ales and ſmall beer; yet it is to be obſerved, that an exact time is not altogether a certain rule in this caſe; for, when looſe hops are boiled in the wort ſo long till they all ſink, their ſeeds will ariſe and fall down again: the wort alſo will be curdled, and broken into ſmall particles if examined in a hand-bowl, but afterwards into larger, as big as great pins heads, and will appear clean and fine at the top. This is ſo much a rule with ſome, that they regard not time, but this ſign, to ſhew when the wort is boiled enough; and this will happen ſooner or later, according to the nature of the barley, and its being well malted; for, if it comes off chalks or gravels, it generally has the good property of breaking or curdling ſoon; but, if off tough clays, then it is longer, which, by ſome perſons, is not a little valued, becauſe it ſaves time in boiling, and conſequently the conſumption of the wort.

It is alſo to be obſerved, that pale malt-worts will not break ſo ſoon in the copper as the brown ſorts; but, when either of their worts boil, it ſhould be to the purpoſe, for then they will break ſooner, and waſte leſs, than if they are kept ſimmering, and will likewiſe work more kindly in the tun, drink ſmoother, and keep longer.

Now all malt-worts may be ſpoiled by too little or too much boiling: If too little, then the drink will always taſte raw, mawkiſh, and be unwholeſome in the ſtomach, where, inſtead of helping to dilute and digeſt our food, it will cauſe obſtructions, cholics, head-achs, and other diſeaſes: Beſides, all ſuch under-boiled drinks are certainly expoſed to ſtaleneſs and ſourneſs, much ſooner than thoſe that have had their full time in the copper. And if they are boiled too long, they will then thicken and not come out of the copper fine and in a right condition. which will cauſe it never to be right clear in the barrel.

But to be more particular, no ale-worts, boiled leſs than an hour, can be good; becauſe, in an hour's time, they cannot acquire a thickneſs of body any ways detrimental to them; and, in leſs than an hour, the ramous viſcid parts of the ale cannot be ſufficiently broke and divided, ſo as to prevent its running into coheſions, ropineſs, and ſourneſs; becauſe in ales there are not hops enough allowed to do this, which good boiling muſt in a great meaſure ſupply, or elſe ſuch drink can never be good; for then its coheſive parts being not thoroughly broke and comminuted by time and boiling, remain hard, and in a good meaſure indigeſtible in the ſtomach: How ignorant then are thoſe people, who, in tippling of ſuch liquor, can praiſe it for excellent good ale, only becauſe its taſte is ſweetiſh, (which is the nature of ſuch raw drinks), believing it to be the pure effect of the genuine malt, and not perceiving the brewer's avarice and cunning, to ſave the conſumption of his wort by ſhortneſs of boiling, tho' to the great prejudice of the drinker's health?

In boiling, both time and the curdling or breaking of the wort ſhould be conſulted; for if a perſon was to boil the wort an hour, and then take it out of the copper before it was rightly broke, it would be wrong management, and the drink would not be fine and wholeſome; and if it ſhould boil an hour and a half, or two hours, without regarding when its particles are in a right order, then it may be too thick; ſo that due care muſt be had to the two extremes, to obtain it in its due order; therefore, in October and keeping beers, an hour and a quarter's good boiling is commonly ſufficient to have a thorough cured drink; for generally in that time it will break and boil enough; becauſe in this there is a double ſecurity by length of boiling, and a quantity of hops ſhifted; but in the new way there is only a ſingle one, and that is by a double or treble allowance of freſh hops boiled only half an hour in the wort; and for this practice a reaſon is aſſigned, that the hops, being endowed with diſcutient apertive qualities, will, by them and their great quantity, ſupply the defect of underboiling the wort; and that a farther conveniency is here enjoyed by having only the fine, wholeſome, ſtrong, floury, ſpirituous parts of the hop in the drink, excluſive of the phlegmetic, earthy parts which would be extracted, if the hops were to be boiled above half an hour; and therefore there are many now that are ſo attached to this new method, that they will not brew ale or beer any other way, thinking, that if hops are boiled above thirty minutes, the wort will exhibit ſome of their bad qualities.

The allowance of hops for ale or beer cannot be exactly adjuſted without coming to particulars, becauſe the proportion ſhould be according to the nature and quality of the malt, the ſeaſon of the year it is brewed in, and the length of time it is to be kept.

For ſtrong brown ale brewed in any of the winter-months, and boiled an hour, one pound is but barely ſufficient for a hogſhead, if it be tapped in three weeks or a month.

If for pale ale brewed at that time, and for that age, one pound and a quarter of hops; but if theſe ales are brewed in any of the ſummer-months, there ſhould be more hops allowed.

For October or March brown beer, a hogſhead made from eleven buſhels of malt boiled an hour and a quarter, to be kept nine months, three pounds and a half ought to be boiled in ſuch drink at the leaſt.

For October or March pale beer, made from fourteen buſhels, boiled an hour and a quarter, and kept twelve months, ſix pounds ought to be allowed to a hogſhead of ſuch drink, and more if the hops are ſhifted in two bags, and leſs time given the wort to boil.

Of

Of Foxing or Tainting Malt-Liquors.

Foxing is a misfortune, or rather a difeafe, in malt-drinks, occafioned by divers means, as the naftinefs of the utenfils, putting the worts too thick together in the backs or coolers, brewing too often and foon one after another, and fometimes by bad malts and waters, and the liquors taken in wrong heats, being of fuch pernicious confequence to the great brewer in particular, that he fometimes cannot recover and bring his matters into a right order again in lefs than a week or two, and is fo hateful to him in its very name, that it is a general law among them to make all fervants that name the word *Fox* or *Foxing* in the brew-houfe to pay fix-pence, which obliges them to call it *Reynard*; for, when once the drink is tainted, it may be fmelt at fome diftance fomewhat like a *Fox:* It chiefly happens in hot weather, and caufes the beer and ale fo tainted to acquire a fulfome fickifh tafte, that will, if it is received in a great degree, become ropy like treacle, and in fome fhort time turn four.

And here we fhall mention the great value of the hop in preventing and curing the fox in malt-liquors. When the wort is run into the tub out of the mafhing-vat, it is a very good way to throw fome hops directly into it before it is put into the copper, and they will fecure it againft fournefs and ropinefs, that are the two effects of foxed worts or drinks, and are of fuch power in this refpect, that raw worts may be kept fome time, even in hot weather, before they are boiled, and which is neceffary where there is a large quantity of malt ufed to a little copper; but it is certain that the ftronger worts will keep longer with hops than the fmaller forts: So likewife, if a perfon has fewer tubs than are wanted, and he is apprehenfive his worts will be foxed by too thick lying in the coolers or working tubs, then it will be a fafe way to put fome frefh hops into fuch tubs, and work them with the yeaft, or, in cafe the drink is already foxed in the vat or tun, new hops fhould be put in and worked with it, and they will greatly fetch it again into a right order; but then fuch drink fhould be carefully taken clear off from its grofs nafty lee, which being moftly tainted, would otherwife lie in the barrel, corrupt, and make it worfe.

Some fift quick-lime into foxed drinks while they are working in the tun or vat, that its fire and falt may break the cohefions of the beer or ale, and burn away the ftench that the corruption would always caufe; but then fuch drink fhould by a peg at the bottom of the vat be drawn off as fine as poffible, and the dregs left behind.

Of fermenting and working of Beers and Ales.

Though a fmall quantity of yeaft be neceffary to ferment and fine the wort; yet it is in itfelf of a poifonous nature, and if beat into the wort too often or in too large a quantity, by its ftupifying and narcotic quality, it makes the liquor fo heady, that five bufhels of malt may be equal in ftrength to fix. But liquor made in this manner is extremely unwholfome.

It is alledged indeed, that beating the yeaft into wort gives it a fine relifh, or it makes the ale bite of the yeaft; but the true reafon is, to further its fale, on account of its intoxicating quality. But fome people are fo fond of white thick ale, that they often kill themfelves by drinking it; nor is their humour much different as to the common brewers brown ale, who, when the cuftomer wants a hogfhead, they put in immediately a handful of falt, and another of flour, and fo bring it up; this is no fooner on the ftilling than it is tapped, that it may carry a froth on the top of the pot, otherwife they defpife it. See Chemistry, *Of fermentation.*

Of working and fermenting London Stout Beer and Ale.

The yeaft is at once put into the tun to work the ftout-beer and ale with; by this means, and the fhortnefs of time we have to ferment our ftrong drinks, we cannot make referves of cold worts to mix with and check the too forward working of thofe liquors. The ftrong beer brewed for keeping is fuffered to be blood-warm in the winter, when the yeaft is put into it, that it may gradually work two nights and a day at leaft, for this will not admit of fuch a hafty operation as the common brown ale, becaufe, if it is worked too warm and hafty, fuch beer will not keep near fo long as that fermented cooler. The brown ale has, indeed, its yeaft put into it in the evening very warm, becaufe it is often carried away the very next morning. The pale or amber ales are often kept near it, not quite a week under fermentation, for the better incorporating the yeaft with the wort.

Of forwarding and retarding the Fermentation of Malt-liquors.

In cafe beer or ale is backward in working, it is cuftomary to caft fome flour out of the dufting-box, or with the hand, over the top of the drink, which will become a fort of cruft or cover to help to keep the cold out: Others put in one or two ounces of powdered ginger, which heats the wort and brings it forward: Others take a gallon ftone-bottle and fill it with boiling water, which, being well corked, is put into the working tub, where it communicates a gradual heat for fome time, and forwards the fermentation: Others referve fome raw wort, which they heat and mix with the reft; but then care muft be taken, that the pot in which it is heated has no manner of greafe about it, left it fhould impede, inftead of promoting the working; but, for retarding and keeping back any drink that is too much heated in working, the cold raw wort is the moft proper of any thing to check it; though fome are known to put one or more pewter difhes into it for that purpofe; or, it may be broke into feveral other tubs, where, by its fhallow lying, its fury will be abated. Others again, to make drink work that is backward, will take the whites of two eggs, and beat them up with half a quartern of good brandy, and put it either into the working-vat, or into the cafk, which will quickly bring it forward, if a warm cloth is put over the bung. Others tie up bran in a coarfe thin cloth, and put it into the vat, where, by its fpongy nature, it abforbs a quantity of the drink, and breeds a heat to forward its working.

Some

Some brewers take off all the top-yeaſt firſt, and then, by a peg near the bottom of the working-tub, draw off the beer or ale, ſo that the dregs are by this means left behind. This is very right, in ales that are to be drank ſoon; but in beers, that are to lie nine or twelve months in a butt or other caſk, there certainly will be wanted ſome *fæces* or ſediments for the beer to feed on, elſe it muſt conſequently grow hungry, ſharp, and eager; and therefore, if its own top or bottom are not put into a caſk with the beer, ſome other artificial compoſition, or lee, ſhould ſupply its place, that is wholeſomer, and will better feed with ſuch drink, than its own natural ſettlement; and therefore, there are here inſerted ſeveral receipts for anſwering this end.

Of artificial Lees for Stout or Stale Beer to feed on.

This article is of very great importance in the curing of our malt-liquors. The general misfortune of the porter or keeping-beers drinking hard and harſh, is partly owing to the naſty foul fæces that lie at the bottom of the caſk, compounded of the ſediments of malt, hops, and yeaſt. Wheat is, by many, put into ſuch beer to feed and preſerve it, as being reckoned a ſubſtantial alcali; however, it has been proved, that ſuch wheat in about three years time has eat into the very wood of the caſk. Others hang a bag of wheat in the veſſel, that it may not touch the bottom; but, in both caſes, the wheat is diſcovered to abſorb and collect the acid qualities of the beer, yeaſt, and hop. Hence it is, that ſuch whole wheat is loaded with the qualities of the unwholeſome ſettlements or grounds of the beer, and becomes of ſuch a corroding nature, as to do miſchief; and, for that reaſon, ſome hang a bag of the flour of malted oats, wheat, peaſe, or beans, in the veſſels of beer, as being of a lighter and mellower body than the whole wheat or its flour, and more natural to the liquor: But whether it be raw wheat or malted, it is ſuppoſed, after this receptacle has emitted its alcalous properties to the beer, and taken in all it can of the acid qualities thereof, that ſuch beer will in time prey upon that again, and ſo communicate its pernicious qualities to the liquor.

Compoſition for feeding Porter or Keeping-Beers.

Take a quart of French brandy, or as much of Engliſh, that is free from any burnt tang, or other ill taſte, and is full proof; to this put as much wheat or bean-flour as will knead it into dough, put it in long pieces into the bung-hole, as ſoon as the beer has done working, or afterwards, and let it gently fall piece by piece to the bottom of the butt; this will maintain the drink in a mellow freſhneſs, keep ſtaleneſs off for ſome time, and cauſe it to be the ſtronger as it grows aged.

Another.

Take one pound of treacle, or honey, one pound of the powder of dried oyſter-ſhells, or fat chalk, mix them well, and put it into a butt, as ſoon as it has done working, or ſome time after, and bung it well; this will both fine and preſerve the beer in a ſoft, ſmooth condition for a great while.

Another.

Take a peck of egg-ſhells, and dry them in an oven, break and mix them with two pounds of fat chalk, and mix them with water wherein four pounds of coarſe ſugar have been boiled, and put it into the butt as aforeſaid.

To fine and preſerve Beers and Ales, by boiling an Ingredient in the Wort.

In each barrel-copper of wort, put in two quarts of whole wheat as ſoon as poſſible, that it may ſoak before it boils; then ſtrain it through a ſieve, and put the wort in cooling-tubs: Thus there will be extracted a gluey conſiſtence, which, being incorporated with the wort by boiling, gives it a more thick and ponderous body, and, when in the caſk, ſoon makes a ſediment or lee, as the wort is more or leſs loaded with the weighty particles of this ſizy body; but if the wheat were firſt parched, or baked in an oven, it would do better, as being rather too raw as it comes from the ear.

To ſtop the Fret in Malt-liquors.

Take a quart of black cherry-brandy, and pour it in at the bung-hole of the hogſhead, and ſtop it cloſe.

To recover deadiſh Beer.

When ſtrong drink grows flat, by the loſs of its ſpirits, take four or five gallons out of a hogſhead, and boil it with five pounds of honey, ſkim it, and, when cold, put it to the reſt, and ſtop it up cloſe: This will make it pleaſant, quick, and ſtrong.

To make ſtale Beer drink new.

Take the herb horehound, ſtamp it and ſtrain it, then put a ſpoonful of the juice (which is an extreme good pectoral) to a pitcher full of beer, let it ſtand covered about two hours, and drink it.

To fine Malt-liquors.

Take a pint of water, half an ounce of unſlacked lime, mix them well together; let it ſtand three hours, and the lime will ſettle to the bottom, and the water be as clear as glaſs; pour the water from the ſediment, and put it into your ale or beer; mix it with half an ounce of iſing-glaſs, firſt cut ſmall and boiled; and in five hours time, or leſs, the beer in the barrel will ſettle, and be clear.

Receipt for making Balls for fining, feeding, preſerving, reliſhing, and colouring Malt Drinks, Wines, and Cyders.

Brown Balls.

Alabaster, or marble calcined into a powder, two pounds. Oyſter-ſhells, a little calcined and freed from their brown or dirt-coloured out-ſide, one pound. Pure fat chalk, well dried, one pound. Horſe-bean flour, firſt freed from the hulls, one pound. Red ſaunders, four ounces. Grains of paradiſe, half an ounce. Florentine orrice-root, half an ounce. Coriander-ſeed, a quarter of an ounce. Cloves, in number ſix. Hops, half an ounce. The beſt ſtaple inciſed iſing-glaſs, two ounces. The firſt runnings of the moloſſes, or treacle, two pounds.

Pale

Pale Balls,

Are made in the ſame manner, and with the like quantity of every thing, except a pound or two of fine ſugar made into a ſyrup, inſtead of the moloſſes, and omitting the faunders.

N. B. The powders are to be pretty fine, and the balls dried very gradually without heat for the firſt three or four days upon brown paper laid over a large ſieve bottom, and turned often. Afterwards they may be put into the ſun, or at a proper diſtance from the fire, in order to dry them thoroughly; and the quantity of the hops may be augmented, or wholly omitted, at diſcretion, according as the liquor requires.

Put as much water to your glaſs as will juſt cover it, in order to open its body, letting it ſtand ſo twelve hours; then add the following infuſion to it, and gradually diſſolve the whole over a gentle fire. Then ſtrain it off hot among ſome of the powder, adding the reſt by a little at a time, with ſome of the treacle or ſyrup likewiſe alternately, till you beat the whole into a ſtiff maſs, out of which form balls weighing four ounces each.

The infuſion.—Pour a pint of boiling water upon the coriander-ſeed, and cloves bruiſed, and the hops well rubbed. Cover them cloſe, and let it ſtand twelve hours, then ſtrain for the uſe aforeſaid.

The number of balls for each caſk.—Powder one of the balls and put it into a pin or half a firkin; into a firkin, two; into a kilderkin, three; into a barrel, ſix; and ſo on in proportion as the caſk is larger or leſſer, ſtirring them well in; and, if the liquor has age enough, ſo that it will bear racking, it ſhould be firſt ſerved ſo, and then they will anſwer much better.

Of the Cellar or Repoſitory for keeping Beers and Ales.

It is certain, that the weather has not only a power or influence in brewing, but alſo after the drink is in the barrel, hogſhead, or butt, in cellars, or other places, which is often the cauſe of forwarding or retarding the fineneſs of malt-liquors; for if we brew in cold weather, and the drink is to ſtand in a cellar of clay, or where ſprings riſe, or waters lie or paſs through ſuch a place, theſe will check the due courſe of the drink, chill, flat, deaden, and hinder it from becoming fine. So likewiſe, if beer or ale is brewed in hot weather, and put into chalky, gravelly, or ſandy cellars, and eſpecially if the windows open to the ſouth, ſouth-eaſt, or ſouth-weſt, then it is very likely it will not keep long, but be muddy and ſtale: Therefore, to keep beer in ſuch a cellar, it ſhould be brewed in October, that the drink may have time to cure itſelf before the hot weather comes on; but, in wettiſh or damp cellars, it is beſt to brew in March, that the drink may have time to fine and ſettle before the winter weather is advanced. Now, cellars ſhould have double or treble doors, that the outer one may be ſhut before the inner one is opened, to keep the air out. If a cellar be kept dry, and have double doors, it is reckoned warm in winter, and cool in ſummer. But the beſt of cellars are thought to be thoſe in chalks, gravels, or ſands; and particularly in chalks, which are of a drying quality more than any other, and conſequently diſſipate damps; which contributes much to the gook keeping of the drink, for all damp cellars are prejudicial to the preſervation of beers and ales, and ſooner bring on the rotting of the caſks and hoops than the dry ones. Beſides, in ſuch incloſed cellars and temperate air, the beers and ales ripen more kindly, are better digeſted and ſoftened, and drink ſmoother: But, when the temperature of the air in the cellar is unequal, the drink ſoon grows ſtale. Though malt-liquor be truly brewed, yet it is often ſpoiled in a bad cellar, that occaſions ſuch alternate fermentations as to make it thick and ſour, though it ſometimes happens that after ſuch changes it fines itſelf again. To prevent theſe commotions of the beer, ſome brew their pale malt in March, and their brown in October; becauſe the pale malt, having not ſo many fiery particles in it as the brown, ſtands more in need of the ſummer's weather to ripen it, while the brown ſort, being more hard and dry, is better able to defend itſelf againſt the winter-colds that will help to ſmooth its harſh particles; yet, when they happen to be too violent, horſe-dung ſhould be laid to the windows as a fortification againſt them.

Some are of opinion, that October is the beſt of all other months to brew any ſort of malt in, by reaſon there are ſo many cold months directly following, that will digeſt the drink and make it much excel that brewed in March, becauſe ſuch beer will not want that care and watching, as that brewed in March abſolutely requires, by often taking out and putting in the vent-peg on change of weather; and, if it is always left out, then it deadens and palls the drink; yet, if due care is not taken in this reſpect, a thunder or ſtormy night may marr all, by making the drink ferment and burſt the caſk; for which reaſon, as iron hoops are moſt in faſhion at this time, they are certainly the greateſt ſecurity to the ſafety of the drink thus expoſed; and next to them is the cheſnut-hoop; both which will endure a ſhorter or longer time, as the cellar is more or leſs dry, and according to the management attending them: The iron hoops generally begin to ruſt firſt at the edges, and therefore ſhould be rubbed off, and be kept from wet as much as poſſible.

Of Cleaning and Sweetening of Caſks.

In caſe your caſk is a butt, then with cold water rinſe out the lees clean, and have ready boiling or very hot water, which put in, and, with a long ſtaſe and a little birch faſtened to its end, ſcrub the bottom as well as you can: At the ſame time let there be provided another ſhorter broom of about a foot and a half long, that with one hand may be ſo employed in the upper and other parts as to clean the caſk well: So in a hogſhead, or other ſmaller veſſel, the one-handed ſhort broom may be uſed with water, or with water, ſand, or aſhes, and be effectually cleaned; the outſide of the caſk about the bung-hole ſhould be well waſhed, leſt the yeaſt, as it works over, carry ſome of its filth with it.

But, to ſweeten a barrel, kilderkin, firkin, or pin, in the great brewhouſes, they put them over the copper-hole

hole for a night together, that the ſteam of the boiling water or wort may penetrate into the wood; this way is ſuch a furious ſearcher, that unleſs the caſk is new-hooped juſt before, it will be apt to fall to pieces.

Another Way.

Take a pottle, or more, of ſtone-lime, and put it into the caſk; on this pour ſome water, and ſtop it up directly, ſhaking it well about.

Another Way.

Take a long linen rag, and dip it in melted brimſtone; light it at the end, and let it hang pendant with the upper part of the rag faſtened to the wooden bung; this is a moſt quick and ſure way, and will not only ſweeten, but help to fine the drink.

Another.

Or, to make your caſk more pleaſant, you may uſe the vintners way thus: Take four ounces of ſtone brimſtone, one ounce of burnt allum, and two ounces of brandy; melt all theſe in an earthen pan over hot coals, and dip therein a piece of new canvas, and inſtantly ſprinkle thereon the powders of nutmegs, cloves, coriander, and aniſe ſeeds: this canvas ſet on fire, and let it burn hanging in the caſk faſtened at the end with the wooden bung, ſo that no ſmoke comes out.

For a muſty Caſk.

Boil ſome pepper in water, and fill the caſk with it ſcalding hot.

To prepare a new Veſſel to keep Malt liquors in.

A new veſſel is moſt improperly uſed by ſome ignorant people for ſtrong drink, after only once or twice ſcalding with water; which is ſo wrong, that ſuch beer or ale will not fail of taſting thereof for half, if not a whole year afterwards. To prevent this inconvenience, when your brewing is over, put up ſome water ſcalding hot, and let it run through the grains; then boil it and fill up the caſk, ſtop it well, and let it ſtand till it is cold; do this twice; then take the grounds of ſtrong drink and boil in it green walnut-leaves and new hay or wheat-ſtraw, and put all into the caſk, that it be full, and ſtop it cloſe: After this, uſe it for ſmall beer half a year together, and then it will be thoroughly ſweet and fit for ſtrong drinks.

Wine-caſks.

These are the cheapeſt of all others to furniſh a perſon readily with, as being many of them good caſks for malt-liquors, becauſe the ſack and white-wine ſorts are already ſeaſoned to hand, and will greatly improve beers and ales that are put in them: But beware of the Rheniſh wine caſks for ſtrong drinks; for its wood is ſo tinctured with this ſharp wine, that it will hardly ever be free of it; and therefore ſuch caſk is beſt uſed for ſmall beer: the claret caſk will a great deal ſooner be brought into a ſerviceable ſtate for holding ſtrong drink, if it is two or three times ſcalded with grounds of barrels, and afterwards uſed for ſmall beer for ſome time. But to cure a claret-caſk of its colour and taſte, put a peck of ſtone-lime into a hogſhead, and pour upon it three pails of water; bung immediately with a wood or cork-bung, and ſhake it well about a quarter of an hour, and let it ſtand a day and night, and it will bring off the red colour, and alter the taſte of the caſk very much.

BREY, a town of the biſhopric of Liege, in Germany, about ſixteen miles north of Maeſtricht; E. long. 5° 40′, and N lat. 51° 15′.

BREYNIA, in botany, a ſynonime of the capparis. See Capparis.

BRIANCON, a town of Dauphiny, in France, ſituated about forty-five miles ſouth-eaſt of Grenoble; E. long. 6° 20′, and N. lat. 44° 50′.

BRIAR, in botany, the Engliſh name of a ſpecies of roſa. See Rosa.

BRIARE, a town of the Iſle of France, ſituated on the river Loire, about ſeventy-five miles ſouth of Paris; E. long. 2° 45′, and N. lat. 47° 40′.

BRIBE, a gift given to a perſon for doing or forbearing any action that he ought to do or forbear.

BRIBERY. See Law.

BRICIANI, thoſe of the order of that name. This was a military order, inſtituted by St Bridget, queen of Sweden, who gave them the rules and conſtitutions of thoſe of Malta and St Auguſtin. This order was approved by pope Urban V. They were to fight for the burying of the dead, to relieve and aſſiſt widows, orphans, the lame, ſick, *&c.*

BRICK, a fat reddiſh earth, formed into long ſquares, four inches broad, and eight or nine long, by means of a wooden mould, and then baked or burnt in a kiln, to ſerve the purpoſes of building.

Bricks are of great antiquity, as appears by the ſacred writings, the tower and walls of Babylon being with them.

In the eaſt, they baked their bricks in the ſun; the Romans uſed them unburnt, only leaving them to dry for four or five years in the air.

The Greeks chiefly uſed three kinds of bricks; the firſt whereof was called [*didōron*,] i. e. of two palms; the ſecond, [*tetradōron*], of four palms; the third, [*pentadōron*], of five palms. They had alſo other bricks, juſt half each of thoſe, to render their works more ſolid, and alſo more agreeable to the ſight, by the diverſities of the figures and ſizes of the bricks.

Pliny ſays, that to make good bricks they muſt not conſiſt of any earth that is full of ſand or gravel, nor of ſuch as is gritty or ſtony; but of a greyiſh marl, or whitiſh chalky clay, or at leaſt of a reddiſh earth: He alſo adds, that the beſt ſeaſon for making bricks is the ſpring; becauſe, if made in ſummer, they will be

be ſubject to crack, and be full of chinks. He directs, that the loam of which bricks are made be well ſteeped and wrought with water.

BRICKS, among us, are various, according to their various forms, dimenſions, uſes, method of making, *&c.* the principal of which are, Compaſs-bricks, of a circular form, uſed in ſteyning of walls: Concave, or hollow bricks, on one ſide flat like a common brick, on the other hollowed, and uſed for conveyance of water: Feather-edged bricks, which are like common ſtatute bricks, only thinner on one edge than the other, and uſed for penning up the brick pannels in timber buildings: Cogging bricks are uſed for making the indented works under the caping of walls built with great bricks: Caping bricks, formed on purpoſe for caping of walls: Dutch or Flemiſh bricks, uſed to pave yards, ſtables, and for ſoap-boilers vaults and ciſterns: Clinkers, ſuch bricks as are glazed by the heat of the fire in making: Sandel or ſamel-bricks, are ſuch as lie outmoſt in a kiln, or clamp, and conſequently are ſoft and uſeleſs, as not being thoroughly burnt: Great bricks are thoſe twelve inches long, ſix broad, and three thick, uſed to build fence-walls: Plaiſter or buttreſs bricks, have a notch at one end, half the breadth of the brick; their uſe is to bind the work which is built of great bricks: Statute-bricks or ſmall common bricks, ought, when burnt, to be nine inches long, four and a quarter broad, and two and a half thick; they are commonly uſed in paving cellars, ſinks, hearths, *&c.*

Bricks are burnt either in a kiln or clamp. Thoſe that are burnt in a kiln, are firſt ſet or placed in it, and then the kiln being covered with pieces of bricks, they put in ſome wood to dry them with a gentle fire; and this they continue till the bricks are pretty dry, which is known by the ſmoke's turning from a darkiſh colour to a tranſparent ſmoke: They then leave off putting in wood, and proceed to make ready for burning, which is performed by putting in bruſh, furze, ſpray, heath, brake, or fern-faggots; but before they put in any faggots, they dam up the mouth or mouths of the kiln with pieces of bricks (which they call *ſhinlog*) piled up one upon another, and cloſe it up with wet brick-earth, inſtead of mortar.

The ſhinlog they make ſo high, that there is but juſt room above it to thruſt in a faggot; then they proceed to put in more faggots, till the kiln and its arches look white, and the fire appears at the top of the kiln; upon which they ſlacken the fire for an hour, and let all cool by degrees. This they continue to do, alternately heating and ſlacking, till the ware be thoroughly burnt, which is uſually effected in forty-eight hours.

About London they chiefly burn in clamps, built of the bricks themſelves, after the manner of arches in kilns, with a vacancy between each brick, for the fire to play through; but with this difference, that inſtead of arching, they ſpan it over by making the bricks project one over another on both ſides of the place, for the wood and coals to lie in till they meet, and are bounded by the bricks at the top, which cloſe all up. The place for the fuel is carried up ſtrait on both ſides, till about three feet high; then they almoſt fill it with wood, and over that lay a covering of ſea-coal, and then overſpan the arch; but they ſtrew ſea-coal alſo over the clamp, betwixt all the rows of bricks; laſtly, they kindle the wood, which gives fire to the coal; and when all is burnt, then they conclude the bricks are ſufficiently burnt.

Oil of BRICKS, olive oil imbibed by the ſubſtance of bricks, and afterwards diſtilled from it. This oil was once in great repute for curing many diſeaſes, but is now entirely laid aſide.

BRICKING, among builders, the counterfeiting of a brick-wall on plaſter, which is done by ſmearing it over with red ochre, and making the joints with an edged tool; theſe laſt are afterwards filled with a fine plaſter.

BRIDE, a woman newly married. Among the Greeks it was cuſtomary for the bride to be conducted from her father's houſe to her huſband's in a chariot, the evening being choſen for that purpoſe, to conceal her bluſhes; ſhe was placed in the middle, her huſband ſitting on one ſide, and one of her moſt intimate friends on the other; torches were carried before her, and ſhe was entertained in the paſſage with a ſong ſuitable to the occaſion. When they arrived at their journey's end, the axle-tree of the coach they rode in was burnt, to ſignify that the bride was never to return to her father's houſe. Among the Romans, when a bride was carried home to her huſband's houſe, ſhe was not to touch the threſhold at her firſt entrance, but was to leap over it.

BRIDEGROOM, a man newly married, the ſpouſe of the bride.

The Spartan bridegrooms committed a kind of rape upon their brides; for matters being agreed on between them two, the woman that contrived and managed the match, having ſhaved the bride's hair cloſe to her ſkin, dreſſed her up in man's cloaths, and left her upon a mattreſs; this done, in came the bridegroom, in his uſual dreſs, having ſupped as ordinary, and ſtealing as privately as he could to the room where the bride lay, and untying her virgin-girdle, took her to his embraces; and having ſtayed a ſhort time with her, returned to his companions, with whom he continued to ſpend his life, remaining with them by night as well as by day, unleſs he ſtole a ſhort viſit to his bride, which could not be done without a great deal of circumſpection, and fear of being diſcovered.

BRIDEWELL, a work-houſe, or place of correction for vagrants, ſtrumpets, and other diſorderly perſons.

Theſe are made to work, being maintained with cloathing and diet; and when it ſeems good to their governors, they are ſent by paſſes into their native countries: however, while they remain here, they are not only made to work, but, according to their crimes, receive, once a-fortnight, ſuch a number of ſtripes as the governor commands. Yet to this hoſpital ſeveral hopeful and ingenious lads are put apprentices, and prove afterwards honeſt and ſubſtantial citizens.

BRIDGE, a work of maſonry or timber, conſiſting of one

one or more arches, built over a river, canal, or the like, for the conveniency of croffing the fame.

Bridges are a fort of edifices very difficult to execute, on account of the inconvenience of laying foundations, and walling under water. The parts of a bridge are the piers, the arches; the pavement, or way over for cattle and carriages; the foot-way on each fide, for foot paffengers; the rail or parapet, which inclofes the whole; and the butments or ends of the bridge on the bank.

The conditions required in a bridge are, that it be well-defigned, commodious, durable, and fuitably decorated. The piers of ftone-bridges fhould be equal in number, that there may be one arch in the middle, where commonly the current is ftrongeft; their thicknefs is not to be lefs than a fixth part of the fpan of the arch, nor more than a fourth; they are commonly guarded in the front with angular fterlings, to break the force of the current: the ftrongeft arches are thofe whofe fweep is a whole femicircle; as the piers of bridges always diminifh the bed of a river, in cafe of inundations, the bed muft be funk or hollowed in proportion to the fpace taken up by the piers (as the waters gain in depth what they lofe in breadth) which otherwife conduce to wafh away the foundation and endanger the piers: To prevent this, they fometimes diminifh the current, either by lengthening its courfe, or by making it more winding; or by ftopping the bottom with rows of planks, ftakes, or piles, which break the current. It is alfo required that the foundation of bridges be laid at that feafon of the year, when the waters are loweft; and if the ground be rocky, hard gravel, or ftony, the firft ftones of the foundation may be laid on the furface; but if the foil be foft fand, it will be neceffary to dig till you come to a firm bottom.

Among the bridges of antiquity, that built by Trajan over the Danube is allowed to be the moft magnificent; it was compofed of twenty arches, of an hundred and fifty feet in height, and their opening from one pier to another was an hundred and fixty feet: The piers of this fine bridge are ftill to be feen in the Danube, being erected between Servia and Moldavia, a little above Nicopolis.

Among modern bridges, that of Weftminfter, built over the river Thames, may be accounted one of the fineft in the world: It is forty-four feet wide, a commodious foot-way being allowed for paffengers, on each fide, of about feven feet broad, raifed above the road allowed for carriages, and paved with broad moor-ftones, while the fpace left between them is fufficient to admit three carriages and two horfes to go a-breaft, without any danger. Its extent from wharf to wharf is 1220 or 1223 feet, being full three hundred feet longer than London-bride. The free water-way under the arches of this bridge is eight hundred and feventy fect, being four times as much as the free water-way left between the fterlings of London-bridge: This difpofition, together with the gentlenefs of the ftream, are the chief reafons why no fenfible fall of water can ever ftop, or in the leaft endanger the fmalleft boats in their paffage through the arches.

It confifts of thirteen large and two fmall arches, together with fourteen intermediate piers.

Each pier terminates with a faliant right angle againft either ftream: the two middle piers are each feventeen feet in thicknefs at the fpringing of the arches, and contain three thoufand cubic feet, or near two hundred tons of folid ftone; and the others decreafe in width equally on each fide by one foot.

All the arches of this bridge are femicircular; they all fpring from about two feet above low-water mark; the middle arch is feventy-fix feet wide, and the others decreafe in breadth equally on each fide by four feet.

This bridge is built of the beft materials; and the fize and difpofition of thefe materials are fuch, that there is no falfe bearing, or fo much as a falfe joint in the whole ftructure; befides that, it is built in a neat and elegant tafte, and with fuch fimplicity and grandeur, that, whether viewed from the water, or by the paffengers who walk over it, it fills the mind with an agreeable furprize. The femioctangular towers, which form the receffes of the foot-way, the manner of placing the lamps, and the height of the baluftrade, are at once the moft beautiful, and, in every other refpect, the beft contrived.

But the moft fingular bridge in Europe is that built over the river Tave in Glamorganfhire. It confifts of one ftupenduous arch, the diameter of which is 175 feet, the chord 140, the altitude 35, and the abutments 32. This magnificent arch was built by William Edward, a poor country-mafon, in the year 1756.

Bridges are either built of ftone or timber, as is judged moft convenient.

Stone-BRIDGES confift of piers, arches, and butments, made of hewn ftone, fometimes alfo intermixed with bricks.

Wooden-BRIDGES are compofed of beams and joifts, fupported by punchions, well cramped and bound together.

Rufhen-BRIDGES are made of great bundles of rufhes, bound faft together, over which planks are laid, and faftened: thefe are put over marfhy places, to ferve for a croffing ground.

Pendent or hanging-BRIDGES, called alfo philofophical bridges, are thofe not fupported by pofts or pillars, but hung at large in the air, fuftained only at the two ends or butments.

Draw-BRIDGE, one that is faftened with hinges at one end only, fo that the other may be drawn up; in which cafe, the bridge ftands upright, to hinder the paffage of a ditch or moat.

Flying or floating BRIDGE, is generally made of two fmall bridges, laid one over the other in fuch a manner, that the uppermoft ftretches and runs out, by help of certain cords, running through pullies placed along the fides of the under bridge, which pufh it forwards, till the end of it joins the place it is intended to be fixed on.

Bridge *of boats*, boats made of copper, and joined ſide by ſide, till they reach a-croſs a river, which being covered with planks, are faſtened with ſtakes or anchors.

Bridge *of communication* is that made over a river, by which two armies, or forts, which are ſeparated by that river, have a free communication with one another.

Floating Bridge, a bridge made uſe of, in form of a work in fortification, called a redoubt, conſiſting of two boats, covered with planks, which are ſolidly framed, ſo as to bear either horſe or cannon.

Bridge, in gunnery, the two pieces of timber which go between the two tranſums of a gun-carriage, on which the bed reſts.

Bridge, in muſic, a term for that part of a ſtringed inſtrument over which the ſtrings are ſtretched. The bridge of a violin is about one inch and a quarter high, and near an inch and a half long.

Bridge-town, the capital of the iſland of Barbadoes: Weſt lon. 56°, and North lat. 13°. It has commodious wharfs for unlading goods, alſo ſome forts and caſtles for the defence of the place.

Bridge-north, a borough-town of Shropſhire, ſituated on the river Severn, about fifteen miles ſouth-eaſt of Shrewſbury: Weſt lon. 2° 30′, and North lat. 52° 40′. It ſends two members to parliament.

Bridgewater, a large borough-town of Somerſetſhire, ſituated near the mouth of the river Evil, in 3° Weſt long. and 51° 15′ North lat. It ſends two members to parliament.

BRIDLE, in the menage, a contrivance made of ſtraps or thongs of leather and pieces of iron, in order to keep a horſe in ſubjection and obedience.

The ſeveral parts of a bridle are the bit, or ſnaffle; the head-ſtall, or leathers from the top of the head to the rings of the bit; the fillet, over the fore-head and under the fore-top; the throat-band, which buttons from the head-band under the throat; the reins, or long thongs of leather that come from the rings of the bit, and being caſt over the horſe's head, the rider holds them in his hand; the noſe band, going through loops at the back of the head-ſtall, and buckled under the cheeks; the trench; the caveſan; the martingal; and the chaff-halter.

Bridles imported pay a duty of 4 s. 9$\frac{45}{100}$d. the dozen; whereof 4 s. 3$\frac{75}{100}$d. is repaid on exporting them again: beſides which they alſo pay 6 s. for every 20 s. value upon oath, without any drawback.

Bridle-hand is the horſeman's left hand, the right hand being the ſpear or ſword hand.

To ſwallow the Bridle, is ſaid of a horſe that has too wide a mouth, and too ſmall a bit-mouth.

BRIDON, or Snaffle, after the Engliſh faſhion, is a very ſlender bit-mouth, without any branches. The Engliſh make much uſe of them, and ſcarcely uſe any true bridles except in the ſervice of war. The French call them bridons, by way of diſtinction from bridles.

BRIDPORT, a borough and port-town of Dorſetſhire, ſituated about ten miles weſt of Dorcheſter; W. long. 3°, and N. lat. 50° 40′.

It ſends two members to parliament.

BRIEF, in Scots law, a writ iſſued from the chancery, directed to any judge-ordinary, commanding and authoriſing that judge to call a jury to inquire into the caſe mentioned in the brief, and upon their verdict to pronounce ſentence.

Apoſtolical Briefs, letters which the pope diſpatches to princes, or other magiſtrates, relating to any public affair.

Theſe briefs are diſtinguiſhed from bulls, in regard the latter are more ample, and always written on parchment, and ſealed with lead or green wax; whereas briefs are very conciſe, written on paper, ſealed with red wax, and with the ſeal of the fiſherman, or St Peter in a boat.

BRIEG, a town of Sileſia, about twenty miles ſouth-eaſt of Breſlaw; E. long. 17° 20′, and N. lat. 50° 50′.

BRIENNOIS, the ſouthern diviſion of the duchy of Burgundy, in France.

BRIEUX, a port-town of Britany, in France, ſituated on the Engliſh channel, about thirty miles weſt of St Malo; W. long. 2° 50′, and N. lat. 48° 40′.

BRIGADE, in the military art, a party or diviſion of a body of ſoldiers, whether horſe or foot, under the command of a brigadier.

An army is divided into brigades of horſe and brigades of foot: a brigade of horſe is a body of eight or ten ſquadrons; a brigade of foot conſiſts of four, five, or ſix battalions.

The eldeſt brigade has the right of the firſt line, and the ſecond the right of the ſecond, and the two next take the left of the two lines, and the youngeſt ſtand in the centre.

Brigade-major, is an officer appointed by the brigadier, to aſſiſt him in the management and ordering of his brigade.

BRIGADIER is the general officer who has the command of a brigade. The eldeſt colonels are generally advanced to this poſt. He that is upon duty is brigadier of the day. They march at the head of their own brigades, and are allowed a ſerjeant and ten men of their own brigade for their guard.

Brigadiers, and Sub-brigadiers, are poſts in the horſe-guards.

BRIGANDINE, a coat of mail, a kind of ancient defenſive armour, conſiſting of thin jointed ſcales of plate, pliant and eaſy to the body.

BRIGANTINE, a ſmall light veſſel, which can both row and ſail well, and is either for fighting or giving chace. It hath about twelve or fifteen benches for the rowers, one man to a bench; all the hands aboard are ſoldiers, and each man hath his muſquet lying ready under his oar.

BRIGG, a market-town in Lincolnſhire, about twenty-four miles north of Lincoln; W. long. 20′, and N. lat. 53° 40′.

BRIGHTELMSTONE, a little port-town in Suſſex, about ſeven miles ſouth-weſt of Lewes; W. long. 10′, and N. lat. 50° 50′.

BRIHUEGA, a town of New Caſtile, in Spain, about forty-three miles north-eaſt of Madrid; W. long. 3° 20′, and N. lat. 41°.

BRILL, or BRIEL, the capital of the iſland of Voorn, in Holland, ſituated about twelve miles ſouth of the Hague; E. long. 4°, and N. lat. 51° 50′.

BRILLIANT, in a general ſenſe, ſomething that has a lucid and bright appearance.

BRILLIANT, in the menage, a briſk, high-mettled, ſtately horſe, is called brilliant, as having a raiſed neck, a fine motion, excellent haunches, upon which he riſes, though never ſo little put on.

BRIM denotes the utmoſt verge or edge, eſpecially of round things.

BRIM, in country affairs. A ſow is ſaid to brim, or to go to brim, when ſhe is ready to take boar.

BRIMSTONE. See SULPHUR, and CHEMISTRY.

BRIMSTONE-*marble*. See MARBLE.

BRIN, a city of Moravia, dependent on Bohemia, about thirty miles ſouth-weſt of Olmutz: E. long. 16° 20′, and N. lat. 49° 40′.

BRINDISI, a port-town of the kingdom of Naples, ſituated on the gulph of Venice, about thirty-five miles north-weſt of Otranto; E. long. 18° 45′, and N. lat. 40° 40′.

BRINE, water replete with ſaline particles; or pickle.

BRINE-*water*, a ſalt water, which being boiled, turns into ſalt.

Brine taken out of brine-pits, or brine-pans, uſed by ſome for curing or pickling of fiſh, without boiling the ſame into ſalt, and rock-ſalt without refining it into white-ſalt, are prohibited by 1 Anne, cap. xxi.

BRINGING-IN *a horſe*, in the menage, the ſame as to ſay, keep down the noſe of a horſe that boars, and toſſes his noſe in the wind; this is done by means of a good branch. See BANQUET, and WIND.

BRION, an iſland of North America, in the gulph of St Lawrence.

BRIONES, a ſmall town of Old Caſtile, in Spain, ſituated on the river Ebro.

BRIONI, the name of three iſlands in the Adriatic ſea, upon the weſtern coaſt of Iſtria. They belong to the Republic of Venice.

BRIONNE, a town of Normandy, in France, ſituated on the Rill, about ten leagues from Rouen.

BRISAC, a fortified town of Swabia, in Germany, ſituated on the eaſtern ſhore of the river Rhine, about thirty miles north of Straſburg; E. long. 7° 15′, and N. lat. 48° 10′.

New BRISAC, a fortreſs on the weſtern ſhore of the Rhine, oppoſite to Old Briſac. It is ſituated in Alſace, and belongs to the French.

BRISGOW, a territory of the circle of Swabia, in Germany, ſituated on the eaſt ſide of the Rhine, oppoſite to the Upper Alſace, whereof Fribourg and Briſac are the chief towns.

BRISTLE, a rigid gloſſy kind of hair, found on ſwine, and much uſed by bruſhmakers, *&c.*

Briſtles, rough and undreſſed, pay a duty of 1 s. $2\frac{36}{100}$d. the dozen pound, whereof 1 s. $\frac{93}{100}$d. is drawn back on exporting them; whereas dreſſed briſtles pay a duty of 2 s. $4\frac{72}{100}$d. the dozen pound, whereof 2 s. $1\frac{87}{100}$d. is drawn back on exportation.

The whiſkers of cats are alſo ſometimes called briſtles; as are the quills of the porcupine.

BRISTOL, a city and port-town of England, ſituated partly in Glouceſterſhire, and partly in Somerſetſhire; W. long. 2° 40′, and N. lat. 51° 30′.

It ſtands on the river Avon, about ninety miles weſt of London, and is a town of the greateſt foreign trade of any in Britain next to London. It is alſo a biſhop's ſee, ſends two members to parliament, and gives the title of earl to the noble family of Harvey.

New BRISTOL, the capital of the county of Bucks, in Penſilvania, about twenty miles north of Philadelphia. It is ſituated on the river Delawar, in 75° W. long. and 40° 45′ N. lat.

BRISTOL-*water*. Theſe waters are the fourth in degree amongſt the waters which are eſteemed warm. The waters of Bath are the firſt, Buxton the ſecond, and Matlock the third.

Bath waters are beneficial, when the ſecretions from the blood are diminiſhed; Briſtol, when too much increaſed: Bath attenuates powerfully; Briſtol incraſſates: Bath is ſpirituous, and helps defects; Briſtol is more cooling, and ſuppreſſes plentitude, with its conſequences, inflammations and hæmorrhages.

If we may judge of the contents of Briſtol waters, from their effects, which are exceedingly deterſive and healing; they partake chiefly of chalk, lapis calcarius, and calaminaris, the virtues of which are too dry to cleanſe; they fill ulcers with fleſh, and cicatrize them.

But whatever the ſubſtances are that impregnate them, it is plain they are very ſubtile, and that there is but little of a terreſtrial part in them, from their ſpecific lightneſs above other waters: Yet when we conſider how agreeable to the ſight, ſmell and taſte; how clear, pure and ſoft they are; their gentle degree of heat, ſo adapted to ſundry diſeaſes; it muſt be concluded, that thoſe waters do imbibe ſome ſalutary particles in their paſſage through the earth; and, from the many cures yearly wrought by them, that they have an undoubted tittle to a place in the firſt claſs of medicinal waters.

The diſeaſes in which Briſtol waters are properly preſcribed, are internal hæmorrhages and inflammations, blood-ſpitting, dyſentery, and immoderate flux of the menſes, purulent ulcers of the viſcera: Hence, in conſumptions, the dropſy, ſcurvy with heat, ſtone, gravel, ſtrangury; the habitual gout, ſcorbutic rheumatiſm, diabetes, ſlow fevers, atrophy, pox, cancer, gleets in both ſexes, king's evil, *&c.*; in all theſe diſorders, Bath waters are not only improper, but hurtful; they rouſe the too languid, and quicken the too lazy circulation; they allay the heat, and reſtrain the too rapid motion of the blood. Thoſe impregnate the phlegmatic, theſe attemperate the choleric conſtitution. Bath water ſeems to be adapted to the maladies of the ſtomach, guts, and nerves; Briſtol, to thoſe of the lungs, kidneys, and bladder: Again, Bath waters are at variance with a milk courſe; and the Briſtol can never be judiciouſly directed, but when they may be joined with reaſon and ſucceſs.

The

The Briſtol waters are taken medicinally only during the hot months, as from April to September.

BRISTOL-*flower*, in botany, a name ſometimes given to the lichnis. See LICHNIS.

BRITAIN, or GREAT-BRITAIN, the moſt conſiderable of all the European iſlands, lies between 50° and 60° N. lat. and between 2° E. long. and 6° W. long.

The general diviſion of Britain, is into South and North Britain, or England and Scotland.

New BRITAIN, a large country of North America, called alſo Terra Labrador, has Hudſon's bay and ſtrait on the north and weſt; Canada and the river of St Lawrence, on the ſouth; and the Atlantic ocean on the eaſt.

It is ſubject to Great-Britain, but yields only ſkins and furs.

BRITANNICA, in botany, the trivial name of a ſpecies of Rumex. See RUMEX.

BRITANY, a province of France, ſurrounded by the Engliſh channel and the bay of Biſcay, on the north, weſt, and ſouth; and bounded on the eaſt by the province of Orleanois.

BRITE, or BRIGHT, in huſbandry. Wheat, barley, or any other grain, is ſaid to brite, when it grows over ripe, and ſhatters.

BRITTLENESS, that quality of bodies, on account of which they are denominated brittle, or which ſubjects them to be eaſily broken.

Brittle bodies are likewiſe very hard and durable, barring accidents; and it is remarkable, that tin, though tough in itſelf, makes all other metals brittle, when mixed with them.

BRIVE LA GAILLARDE, a town of France in the Limouſin, upon the Coureze.

BRIXEN, a city of Tyrol in Germany, about fifty miles north-eaſt of Trent: E. long. 11° 45′, N. lat. 46° 45′.

BRIZA, a genus of the triandria digynia claſs. There are five ſpecies of Briza, two of which are natives of Britain, *viz.* the media or middle quaking graſs, and the minor or ſmall quaking-graſs. They grow in paſture-grounds.

BRIZE, in huſbandry, denotes ground that has lain long untilled.

BRIZE-*vents*, ſhelters uſed by gardeners who have not walls on the north-ſide, to keep cold winds from damaging their beds of melons. They are incloſures about ſix or ſeven feet high, and an inch or more thick; made of ſtraw, ſupported by ſtakes fixed into the ground, and props acroſs on both inſide and outſide; and faſtened together with willow twigs, or iron-wire.

BROADALBIN, a diſtrict or county of Perthſhire, in Scotland, bordering upon Argyleſhire: It gives the title of earl to a branch of the noble family of Campbell.

BROAD-*ſide*, in the ſea-language, denotes a volley of cannon, or a general diſcharge of all the guns on one ſide of a ſhip at once.

BROCADE, or BROCADO, a ſtuff of gold, ſilver, or ſilk, raiſed and enriched with flowers, foliages, and other ornaments, according to the fancy of the merchants or manufacturers.

Formerly the word ſignified only a ſtuff, wove all of gold, both in the warp and in the woof, or all of ſilver, or of both mixed together; thence it paſſed to thoſe of ſtuffs in which their was ſilk mixed, to raiſe and terminate the gold or ſilver flowers: But at preſent all ſtuffs, even thoſe of ſilk alone, whether they be grograms of Tours or of Naples, ſattins, and even taffeties or luſtrings, if they be but adorned and worked with ſome flowers, or other figures, are called brocades.

BROCADE-*ſhell*, the Engliſh name of a ſpecies of limax. See LIMAX.

BROCATEL, or BROCADEL, a kind of coarſe brocade; chiefly uſed for tapeſtry.

BROCCOLI, a kind of cabbage cultivated for the uſe of the table; the manner of dreſſing which is this: When their heads are grown to their full bigneſs, they are to be cut off, with about four inches of the tender ſtem; the outer ſkin is then to be ſtripped off the ſtem, after which they are to be waſhed, and boiled in a clean linnen cloth, as is practiſed for cauliflowers.

They are tenderer than any cauliflower, though very like them in taſte.

BROCK, among ſportſmen, a term uſed to denote a badger.

A hart too of the third year is called a brock, or brocket; and a hind of the ſame year, a brocket's ſiſter.

BROD, a town of Sclavonia, ſituated on the river Save, about ſixteen miles ſouth of Poſega: E. long. 18° 50′, N. lat. 45° 20′.

BRODERA, or BRODRA, a city of Aſia, in the country of the Mogul and kingdom of Guzurat, where there is a great trade in cotton cloths: E. long. 73° 30′, N. lat. 22° 25′.

BRODIUM, a pharmaceutical term, ſignifying the ſame as juſculum, or the liquor in which ſome ſolid medicine is preſerved, or with which ſomething elſe is diluted.

BROGLING *for eels*, the ſame with ſniggling. See SNIGGLING.

BROGLIO, a town of Peidmont in Italy, ſituated near the frontiers of Provence, about twenty five miles north-weſt of Nice: E. long. 6° 42′, N. lat. 44° 12′.

It is the capital of a county of the ſame name.

BROITSCHIA, a city of Aſia in Indoſtan, about twelve leagues from Surat.

BROKEN *wind*, among farriers, is a malady that happens to a horſe when he is ſuffered to ſtand too long in the ſtable, without exerciſe: By this means he contracts groſs and thick humours in ſuch abundance, that, adhering to the hollow parts of his lungs, they ſtop his wind-pipe.

This diſtemper is known by the horſe's heaving and drawing up his flanks together, and blowing wide his noſtrils.

To cure this diſorder, take the guts of a hedge-hog, dry

dry them, and pound them to powder, and give the horſe two or three ſpoonfuls of it in a pint of wine or ſtrong ale; then mix the reſt with aniſe-ſeed, liquorice, and ſweet butter, of which make round balls, or pills, and give him two or there of them after drink, and let him faſt two or three hours.

BROKER, a name given to perſons of ſeveral and very different profeſſions, the chief of which are exchange-brokers, ſtock-brokers, pawn-brokers, and brokers, ſimply ſo called, who ſell houſehold-furniture, and ſecond-hand apparel.

Exchange-BROKERS are a kind of agents, or negotiators, who contrive, propoſe, and conclude bargains between merchants, and between merchants and tradeſmen, in matters of bills of exchange, or merchandiſe, for which they have ſo much commiſſion. Theſe, by the ſtatute of 8 and 9 William III. are to be licenſed in London by the Lord Mayor, who gives them an oath, and takes bond for the faithful execution of their offices. If any perſon ſhall act as broker, without being thus licenſed and admitted, he ſhall forfeit the ſum of 500 l. and perſons employing him 5 l. and brokers are to regiſter contracts, *&c.* under the like penalty: Alſo brokers ſhall not deal for themſelves, on pain of forfeiting 200 l. They are to carry about with them a ſilver medal, having the king's arms, and the arms of the city, and pay 40s. a year to the chamber of the city.

The exchange brokers make it their buſineſs to know the alteration of the courſe of exchange, to inform merchants how it goes, and to give notice to thoſe who have money to receive or pay beyond ſea; they are the proper perſons for negotiating the exchange, and when the matter is accompliſhed, that is, when the money for the bill is paid, and the bill delivered, they have for brokerage 2 s. for 100l. ſterling.

They reckon at Paris, among the city-officers, who are employed under the juriſdiction of the provoſt of the merchants, and *echevins* or aldermen, three ſorts of brokers.

1. The brokers of horſes for the carriage of merchandiſe by water; they are eſtabliſhed for the navigation, and take care to examine the horſes uſed to draw the boats up the river; to ſet the horſes together, to oblige the carriers to repair their boats, or to break ſuch as are no longer fit to ſerve.

2. Sworn wine-brokers on the keys, to examine and taſte all the wine that arrives there.

3. Brokers of bacon and lard. Theſe are eſtabliſhed to examine thoſe ſorts of merchandiſes, as they are landed or unloaded, and to anſwer for their goodneſs to the buyer, and to the ſeller, for the price of his wares.

Stock-BROKERS, are thoſe who are employed to buy and ſell ſhares in the joint ſtock of a company, or corporation.

As the practice of ſtock-jobbing has been carried on to ſuch an exceſs as became not only ruinous to a great number of private families, but even affected, or at leaſt might ſoon affect, the public credit of the nation, the legiſlature thought fit to put a ſtop to it, or at leaſt to bring it withing certain bounds, and under ſome regulation, by ſtatute 7 George II. c. viii. ſect. 1.

Pawn-BROKERS. Perſons who keep ſhops, and lend money upon pledges to neceſſitous perſons, and moſt commonly at an exorbitant intereſt. They are more properly ſtyled pawn-takers, or tally-men, ſometimes fripers, or friperers. Theſe are meant in 1 Jac.I. cap. xxi. ſect. 5. where it is declared, that the ſale of goods wrongfully taken to any broker, or pawn-broker in London, Weſtminſter, Southwark, or within two miles of London, does not alter the property.

And ſect. 7. If a broker, having received ſuch goods, ſhall not, upon requeſt of the owner, diſcover them, how and when he came by them, and to whom they are conveyed, he ſhall forfeit the double value thereof, to be recovered by action of debt, *&c.*

In the cities of Italy, there are companies eſtabliſhed by authority for the letting out money on pawns, called *mounts of piety*; a title little becoming ſuch inſtitutions, as the loan is not gratis. In ſome parts of Italy, they have alſo mounts of piety of another kind, wherein they only receive ready money, and return it again with intereſt, at a certain ſum *per annum*.

At Bologna, they have ſeveral ſuch mounts, which are diſtinguiſhed into frank and perpetual; the intereſt of the former is only four *per cent.* that of the latter, ſeven.

BROKERS are alſo thoſe who ſell old houſehold-furniture, and wearing apparel, *&c.*

BROMELIA, or pine apple, in botany, a genus of the hexandria monogynia claſs. The calix is divided into three ſegments; it has three petals, and there is a ſcaly nectarium at the baſe of each petal; the berry has three cells. There are five ſpecies of bromelia, *viz.* the ananas or common pine-apple, which is a native of Surinam and New Spain; the pinguin, a native of Jamaica and Barbadoes; the karatos, lingulata, and nudicaulis, all natives of the ſouthern parts of America.

BROMSGROVE, a market-town in Worceſterſhire, about ten miles north of Worceſter: W. long. 2° 5′, N. lat. 52° 26′.

BROMLEY, a market-town of Kent, ten miles ſouth-eaſt of London: E. long. 5′, N. lat. 51° 25′.

BROMLEY is alſo the name of a market-town of Staffordſhire, about ten miles eaſt of Stafford: W. long. 1° 50′, N. lat. 52° 45′.

BROMOIDES, in botany. See FESTUCA.

BROMUS, in botany, a genus of the triandria digynia claſs. The calix is double-valved; the ſpica is oblong and cylindrical; the awn is below the apex. There are 17 ſpecies, eight of which are natives of Britain, *viz.* the ſecalinus or field brome-graſs, the arvenſis or corn brome graſs, the ciliatus or wall brome-graſs, the ſterilis or barren brome-graſs, the giganteus or tall brome-graſs, the ramoſus or wood brome graſs, and the pinnatus or ſpiked brome-graſs.

BRONCHIA, in anatomy, the ramifications of the trachea. See p. 280. (col. 2.) & p. 281.

BRONCHOCELE, in ſurgery, a tumour ariſing in the anterior part of the neck. See SURGERY.

BRONCHOTOMY, in furgery, an incifion made in the afpera arteria, or wind-pipe, which is neceffary in many cafes, and efpecially in a violent quinfey, to prevent fuffocation from the great inflammation or tumor of the parts. It is alfo called laryngotomy and tracheotomy. See SURGERY.

BRONCHUS, according to Galen, is the afpera arteria which reaches from the larynx to the lungs, confifting of the bronchia.

Sometimes it is put for the whole afpera arteria; and Hippocrates ufes it to fignify the throat.

BRONTIÆ, or THUNDER-STONES, in natural hiftory. See BELEMNITES.

BRONTIUM, in Grecian antiquity, a place underneath the floor of the theatres, in which were kept brazen veffels full of ftones and other materials, with which they imitated the noife of thunder.

BRONTOLOGY denotes the doctrine of thunder, or an explanation of its caufes, phænomena, *&c.* together with the prefages drawn from it. See THUNDER, and ELECTRICITY.

BRONZE, a compound metal, confifting of one part of tin, ten of copper, and a little zinc. See CHEMISTRY.

BRONZES, a name given by antiquarians to figures either of men or beafts, to urns, and, in general, to every piece of fculpture which the ancients made of that metal. We likewife give the name of bronzes to ftatues or bufts caft of bronze, whether thefe pieces be copies of antiques, or original fubjects.

Among medallifts, all copper medals bear the name of bronze.

BRONZING, the art of varnifhing wood, plafter, ivory, *&c.* fo as to give them the colour of bronze. See VARNISHING.

BROOD, the young of fifh, fowls, *&c.*

BROODING, the act of a hen in hatching her eggs. See HATCHING.

BROOK, a little river or fmall current of water.

A brook is diftinguifhed from a river infomuch as a river flows at all times, whereas a brook flows at fome particular feafons only.

BROOK-*lime.* See ANAGALLIS.

BROOM, in botany. See GENISTA.

Butchers-BROOM, the Englifh name of the rufcus. See SPARTIUM.

Spanifh-BROOM, in botany. See SPARTIUM.

BROOM-FLOWER, *ordre de la genifte*, an order inftituted by St Louis, king of France, to fhew the efteem which he had for the queen his wife, who, the evening before his queen's coronation, received this order himfelf.

BROOM-RAPE, in botany. See OROBANCHE.

BROOMING, or BREAMING, *of a fhip*, the wafhing and burning off all the filth that fhe has contracted on her fides with weeds, ftraw, broom, or the like, when fhe is on the careen, or on the ground. See CAREENING.

BROTHEL. See STEWS.

BROTHER, a term of relation between male children, fprung from the fame parents, or from the fame father, or the fame mother.

The ancients ufed the term brother, indifferently, to almoft all who ftood related in the collateral line, as uncles and nephews, coufins-german, *&c.*

According to the laws of Mofes, the brother of a man, who died without children, was obliged to marry the widow of the deceafed, in order to raife up children to him, that his name and memory might not be extinct. See the article WIDOW.

Among us, it is cuftomary for kings to give the title brother to each other.

In the civil law, brothers, *fratres*, in the plural number, fometimes comprehends fifters.

BROTHER is alfo a cuftomary term for priefts of the fame perfuafion to addrefs one another by; but it is more particularly ufed to denote the relation between monks of the fame convent, as father Zachary: In Englifh, we more ufually fay, Friar Zachary, from the French word *frere*, brother. Preachers alfo call their hearers, my brethren, or my dear brethren; and fometimes they ufe the fingular number, and fay, my brother.

This appellation is borrowed from the primitive Chriftians, who all called each other brothers: but it is now principally ufed for fuch of the religious as are not priefts; thofe in orders are generally honoured with the title of father, whereas the reft are only fimply brothers.

BROTHERS-GERMAN. See GERMAN.

BROTHERS *of the rofy-crofs.* See ROSICRUCIAN.

BROUCK, the name of a town of Germany, in the circle of Weftphalia, upon the river Roer; and likewife of a town of Switzerland, upon the banks of the Aar.

BROUERSHAVEN, a port-town of Zeland, in the united Netherlands, fituated on the north fide of the ifland of Schonen, about nine miles fouth-weft of Helvoetfluys: E. lon. 3° 55′, and N. lat. 51° 50′.

BROW, or EYE-BROW, an hairy arch extended over the orbit of each eye. See p. 291. col. 1.

BROW-POST, among builders, denotes a beam which goes acrofs a building.

BROW-ANTLER, among fportfmen, that branch of a deer's horn next the tail.

BROWALLIA, in botany, a genus of the didynamia angiofpermia clafs. The calix has five teeth; the limbus of the corolla is divided into five equal and open fegments; and the capfule is unilocular.

BROWN, among dyers, painters, *&c.* a dufky colour, inclining towards rednefs. Of this colour there are various fhades or degrees, diftinguifhed by different appellations; for inftance, Spanifh-brown, a fad-brown, a tawney-brown, the London brown, a clove-brown, *&c.*

Spanifh-brown is a dark dull red, of a horfe-flefh colour. It is an earth, and is of great ufe among painters, being generally ufed as the firft and priming colour that they lay upon any kind of timber-work in houfe-painting. That which is of the deepeft colour, and freeft from ftones, is the beft. Though this is of a dirty brown colour, yet it is much ufed, not to colour any garment, unlefs it be an old man's gown;

gown; but to ſhadow vermillion, or to lay upon any dark ground behind a picture, or to ſhadow yellow berries in the darkeſt places, when you want lake, *&c.* It is beſt and brighteſt when burnt in the fire, till it be red hot, although, if you would colour any hare, horſe, dog, or the like, it ſhould not be burnt; but, for other uſes, it is beſt when it is burnt; as for inſtance, for colouring wood, poſts, bodies of trees, or any thing elſe of wood, or any dark ground of a picture. See DYING.

BROWNISTS, in church-hiſtory, a religious ſect, which ſprung up in England towards the end of the XVIth century. Their leader was one Robert Brown, born at Northampton. They ſeparated from the eſtabliſhed church, on account of its diſcipline and form of government. They equally diſliked epiſcopacy and preſbyterianiſm. They condemned the ſolemn celebration of marriages in churches, maintaining, that matrimony being a political contract, the confirmation of it ought to proceed from the civil magiſtrate. They rejected all forms of prayer, and held, that the Lord's prayer was not to be recited as a prayer; being given only as a model, upon which to form our prayers.

BRUCA, the name of a river and ſea-port town of Sicily, in the valley of Noto.

BRUCHSAL, a town of the biſhopric of Spires, in the palatinate of the Rhine, in Germany: E. lon. 8° 30′, and N. lat. 49° 15′.

BRUCHUS, in zoology, a genus of inſects belonging to the order of caleoptera. The feelers are filiform, and gradually increaſe in thickneſs. There are ſeven ſpecies, viz. the piſi, has grey elytra interſperſed with white ſpots, and a white fundament with two black ſpots. It is a native of North America, and deſtroys whole fields of peaſe: It is now found in ſeveral of the ſouthern parts of Europe; where it does great injury to the corn. 2. The theolromæ with whitiſh elytra interſperſed with black points. It frequents the theolroma or chocolate trees in the Eaſt Indies. 3. The gleditſiæ, with ſtriated elytra of the ſame length with the belly, a pitch-coloured body, and green feelers. It is a native of America. 4. The bactris, with ſmooth elytra, a hoary body, and the hind part of the thighs oval. It frequents the palm-trees of Jamaica. 5. The granarius, has black elytra; the fore-feet are red, and the hind-feet are dentated. It frequents the ſeeds of plants in different parts of Europe. 6. The ſemiparius is black, with the baſe of the feelers and fore-feet teſtaceous. It is about the ſize of a louſe, and a native of Europe. 7. The pectinicornis, with comb-ſhaped feelers longer than the body. It is a native of Barbary and China.

BRUGES, a city and port-town of Flanders, eleven miles eaſt of Oſtend, and twenty-four north-weſt of Ghent: E. lon. 3° 5′, and N. lat. 51° 16′.

There is a navigable canal from Oſtend to Bruges, which has ſtill the beſt foreign trade of any town in Flanders.

BRUISE, in ſurgery, the ſame with contuſion. See CONTUSION, and SURGERY.

BRUMALIA, in Roman antiquity, feſtivals of Bacchus celebrated twice a-year; the firſt on the twelfth of the calends of March, and the other on the eighteenth of the calends of November. They were inſtituted by Romulus, who, during theſe feaſts, uſed to entertain the ſenate. Among other heathen feſtivals which the primitive Chriſtians were much inclined to obſerve, Tertullian mentions the brumæ or brumalia.

BRUNELLA, in botany. See PRUNELLA.

BRUNIA, in botany, a genus of the pentandria monogynia claſs. The flowers are aggregated; the filaments of the ſtamina are inſerted into the ungues of the petals; the ſtigma is bifid, and the ſeeds are ſingle. There are ſix ſpecies, all natives of Æthiopia.

BRUNSBUTTEL, a port-town of Holſtein, in the circle of Lower Saxony, in Germany, ſituated at the mouth of the river Elbe: E. lon. 8° 42′, and N. lat. 54° 10′. It is ſubject to Denmark.

BRUNSFELSIA, in botany, a genus of the pentandria monogynia claſs. The corolla is long and ſhaped like a tunnel; the berry is unilocular, and contains many ſeeds.

BRUNSWICK, the capital of the duchy of Brunſwick, in the circle of Lower Saxony, in Germany, ſituated on the river Ocker, about 35 miles eaſt of Hanover: E. lon. 10° 30′, and N lat. 52° 30′.

The elector of Hanover is ſtyled duke of Brunſwick, though he has no property in, or dominion over, the city of that name, which belongs to the duke of Brunſwick Wolfembuttle.

BURNTISLAND, a parliament-town on the coaſt of Fife, in Scotland, about ten miles north-weſt of Edinburgh; W. long. 3°, and N. lat. 56° 12′.

BRUSH, an inſtrument made of briſtles, hair, wire, or ſmall twigs, to clean cloaths, rooms, *&c.* and alſo to paint with. There are various ſorts of them, diſtinguiſhed by their ſhape or uſe. In the choice of painters bruſhes, obſerve whether the briſtles are faſt bound in the ſtocks, and if the hair be ſtrong and lie cloſe together; for if they ſprawl abroad, ſuch will never work well; and if they are not faſt bound in the ſtock, the briſtles will come out when you are uſing them, and ſpoil your work, as may be ſeen where the looſe hairs of the bruſh have lain up and down in the colours laid on, to the great detriment of the work.

Wine-bruſhes are of uſe for ſcrubbing thoſe ſilver, copper, and braſs pieces, which are to be gilded over, in order to clear them perfectly from any dirt, ruſt, or filth, which may adhere to them, and, if not bruſhed off, would hinder the cloſing of the gold with them. They are therefore uſed by gilders, ſilverſmiths, *&c.* and are uſually ſold by ironmongers. Beard-bruſhes pay a duty, on importation, of 1 s. $3\frac{40}{100}$d. the groſs or twelve dozen; whereof 1 s. $1\frac{1}{2}$ is drawn back on exporting them. Comb-bruſhes pay 2 s. $6\frac{80}{100}$d. for the ſame number; and of this 2 s. 3 d. is repaid. Head-bruſhes pay 1 s. $3\frac{40}{100}$d. the dozen; rubbing-bruſhes $3\frac{8}{100}$d. the dozen; weavers-bruſhes $11\frac{55}{100}$d. for the ſame number; in all which a proportional drawback

drawback is allowed. However, it is to be obſerved, that bruſhes are among the number of goods prohibited to be imported.

BRUSSELS, the capital of the province of Brabant, and of all the Auſtrian Netherlands. It is ſituated on the river Senne, and is the ſee of a biſhop; W. long. 4° 6′, and N. lat. 50° 50′.

It is a ſtrong fortified town, and agreeably ſituated, which, together with the viceroy's reſidence, occaſions a great reſort of nobility and gentry.

BRUTE, an animal guided moſtly by mere inſtinct, and comprehends all animals, excepting mankind.

BRUTON, a market-town in Somerſetſhire, about ten miles ſouth-eaſt of Wells; W. long. 2° 35′, and N. lat. 51° 15′.

BRYANSBRIDGE, a town of Ireland, in the county of Clare, and province of Connaught, ſituated on the river Shannon, about eight miles north of Limerick.

BRYGMUS, among phyſicians, a grating noiſe made by the gnaſhing of teeth.

BRYONIA, in botany, a genus of the monœcia ſyngeneſia claſs. The calix of the male has five teeth; the corolla is divided into five ſegments; and there are three filaments. The calix of the female is likewiſe teethed; the corolla has five diviſions; the ſtylus is trifid; and the berry is roundiſh, and contains many ſeeds. There are ſix ſpecies of bryony, only one of which, *viz.* the alba, or white bryony, is a native of Britain. The root is a ſtrong cathartic, and, applied externally, is ſaid to be a powerful diſcutient.

Black-Bryony. See Tamus.

BRYUM, in botany, a genus of the cryptogamia muſci claſs. The anthera is covered with an operculum; the calyptra is ſmooth. There are 41 ſpecies, moſt of them natives of Britain.

BUBALIS, in zoology, the trivial name of the buffalo, a ſpecies of the bos. See Bos.

BUBBLE, in philoſophy, ſmall drops or veſicles of any fluid filled with air, and either formed on its ſurface, by an addition of more of the fluid, as in raining, *&c.*; or in its ſubſtance, by an inteſtine motion of its component particles. Bubbles are dilatable or compreſſable, *i. e.* they take up more or leſs room, as the included air is more or leſs heated, or more or leſs preſſed from without, and are round, becauſe the included air acts equally from within, all around.

Bubble, in commerce, a cant term given to a kind of project for raiſing of money on imaginary grounds, much practiſed in France and England in the years 1719, 1720, and 1721.

The pretence of thoſe ſchemes was the raiſing a capital for retrieving, ſetting on foot, or carrying on ſome promiſing and uſeful branch of trade, manufacture, machinery, or the like: To this end propoſals were made out, ſhewing the advantages to be derived from the undertaking, and inviting perſons to be engaged in it. The ſum neceſſary to manage the affair, together with the profits expected from it, were divided into ſhares or ſubſcriptions, to be purchaſed by any diſpoſed to adventure therein.

Bubbles, by which the public have been tricked, are of two kinds, *viz.* 1. Thoſe which we may properly enough term trading-bubbles; and, 2. Stock or fund-bubbles. The former have been of various kinds; and the latter at different times, as in 1719 and 1720.

BUBO, in ornithology, the trivial name of a ſpecies of ſtrix. See Strix.

Bubo, or Buboe, in ſurgery, a tumour which ariſes, with inflammation, only in certain or particular parts to which they are proper, as in the arm-pits and in the groins. See Medicine, and Surgery.

BUBON, in botany, a genus of the pentandria digynia claſs. The fruit is oval, ſtriated, and hairy. There are four ſpecies, and none of them natives of Britain.

BUBONOCELE, or Hernia inguinalis, in ſurgery, a tumour in the inguen, formed by a prolapſus of the inteſtines, omentum, or both, through the proceſſes of the peritonæum, and rings of the abdominal muſcles. See Surgery.

BUBONIUM, in botany, a ſynonime of the inula. See Inula.

BUCANEPHYLLON, in botany, the name by which Plukenet calls the ſarracena. See Sarracena.

BUCARDIA, or Bucarditæ, in natural hiſtory, a kind of figured ſtones, formed in the cavities of the larger cockles, and reſembling, in ſome meaſure, a heart at cards.

BUCARIZA, a town of the kingdom of Hungary, in Croatia, upon the Adriatic ſea, in a gulf that takes the ſame name.

BUCCA *ferrea*, in botany, a name given by Micheli to the ruppia of Linnæus. See Ruppia.

BUCCAL, ſomething belonging to the cheeks: Thus, the buccal glands, are thoſe diſperſed over the inner ſide of the cheeks.

BUCCANEERS, thoſe who dry and ſmoke fleſh or fiſh, after the manner of the Americans.

This name is particularly given to the French inhabitants of the iſland of St Domingo, whoſe whole employment is to hunt bulls, or wild boars, in order to ſell the hides of the former, and the fleſh of the latter.

The buccaneers are of two ſorts: The buccaneers ox-hunters, or rather hunters of bulls and cows; and the buccaneers boar-hunters, who are ſimply called hunters; though it ſeems, that ſuch a name be leſs proper to them than the former; ſince the latter ſmoke and dry the fleſh of wild boars, which is properly called buccaneering, whereas the former prepare only the hides, which is done without buccaneering.

Buccaneering is a term taken from Buccan, the place where they ſmoke their fleſh or fiſh, after the manner of the ſavages, on a grate or hurdle, made of Braſil wood, placed in the ſmoke, a conſiderable diſtance from the fire: This place is a hut, of about twenty-five or thirty feet in circumference, all ſurrounded and covered with palmetto leaves.

Buccaneers alſo ſignify thoſe famous adventurers of all the nations in Europe, who join together to make war againſt the Spaniards of America, cruiſing about in privateers, to take all the veſſels and ſmall craft they can meet with.

BUCCARI,

BUCCARI, a town of Iſtria upon the Adriatic ſea, belonging to the houſe of Auſtria.

Buccari, or Bouchari, is alſo the name of a large province of Aſiatic Tartary, ſituated between 78° and 90° E. lon. and 34° and 44° N. lat.

BUCCELLARII, an order of ſoldiery under the Greek emperors, appointed to guard and diſtribute the ammunition-bread; though authors are ſomewhat divided as to their office and quality. Among the Viſigoths, buccellarius was a general name for a client or vaſſal who lived at the expence of his lord. Some give the denomination to paraſites in the courts of princes, ſome make them the body-guards of emperors, and ſome fancy they were only ſuch as emperors employed in putting perſons to death privately.

BUCCINA, an ancient muſical and military inſtrument. It is uſually taken for a kind of trumpet; which opinion is confirmed by Feſtus, by his defining it a crooked horn, played on like a trumpet. Vegetius obſerves, that the buccina bent in a ſemicircle, in which reſpect it differed from the tuba or trumpet. It is very hard to diſtinguiſh it from the cornu or horn, unleſs it was ſomething leſs, and not quite ſo crooked; yet it certainly was of a different ſpecies, becauſe we never read of the cornu in uſe with the watch, but only the buccina. Beſides, the ſound of the buccina was ſharper, and to be heard much farther, than either the cornu or the tuba. In ſcripture, the like inſtrument, uſed both in war and in the temple, was called ramshorns, kiren-jobel, and ſopheroth hagijobelim.

BUCCINUM or Trumpet-shell, a genus of ſhellfiſh belonging to the order of vermes teſtaceæ. This animal is one of the ſnail kind. The ſhell is univalve, ſpiral, and gibbous. The aperture is oval, ending in a ſmall ſtrait canal. Linnæus enumerates about ſixty ſpecies, moſt of which are found in the ſouthern ſeas.

BUCCO, in ornithology, a genus belonging to the order of picæ. The beak is cultrated, turned inwards, compreſſed on the ſides, and emarginated on each ſide at the apex; and there is a long ſlit below the eyes. The noſtrils are covered with feathers. The feet have four toes, two before and two behind. There is but one ſpecies, viz. the capenſis, which is of a reddiſh colour, with a yellow belt round the ſhoulders, and a black one round the breaſt. It is found at the Cape of Good-Hope.

BUCCULA, in antiquity, denotes the umbo, or moſt prominent part in the middle of a ſhield; ſo called, becauſe uſually faſhioned like the mouth or face of a man or other animal.

BUCENTAUR, a galeas, or large galley of the doge of Venice, adorned with fine pillars on both ſides, and gilt over from the prow to the ſtern. This veſſel is covered over head with a kind of tent, made of purple ſilk. In it the doge receives the great lords and perſons of quality that go to Venice, accompanied with the ambaſſadors and counſellors of ſtate, and all the ſenators ſeated on benches by him. The ſame veſſel ſerves alſo in the magnificent ceremony of aſcenſion-day, on which the Duke of Venice throws a ring into the ſea to eſpouſe it, and to denote his dominion over the gulph of Venice.

Bucentaur is alſo the name of a ſhip, as great and s magnificent as that of the Venetians, built by order of the elector of Bavaria, and launched on a lake, which is ſix leagues in length.

BUCEROS, in ornithology, a genus belonging to the order of picæ. The beak is convex, cultrated, very large, and ſerrated outwards: The fore-head is naked, with a bony gibboſity. The noſtrils are behind the baſe of the beak. The tongue is ſharp and ſhort. The feet are of the greſſarii kind, i. e. the toes are diſtinct from each other. There are four ſpecies of the buceros, viz. 1. The bicornis, with a flat bony fore-head, and two horns before. The body is black, and about the ſize of a hen; but the breaſt, belly and thighs are white. There is a white ſpot on the wing; the tail is long, with ten black prime feathers, and the four outermoſt on each are white. The feet are greeniſh, with three toes before and one behind. It is a native of China, and called Calao by Willoughby and other authors. 2. The hydrocorax, or Indian crow of Ray, has a plain bony fore-head without any horns. The body is yellowiſh, and blackiſh below. It inhabits the Molucca iſles. 3. The rhinoceros, has a crooked horn in the fore-head joined to the upper mandible. It is a native of India, and feeds upon carion. 4. The naſutus, has a ſmooth fore-head. It is about the ſize of a magpye, and is a native of Senegal.

BUCH, a town of Guienne, in France, which gives its name to a territory called *le Capitulat de Buch.*

BUCHAN, a country or diſtrict of Aberdeenſhire, in Scotland: It gives the title of Earl to the noble and ancient family of Erſkine.

BUCHNERA, in botany, a genus of the didynamia angioſpermia claſs. The calix has five teeth; the corolla is divided into five equal heart-ſhaped ſegments; and the capſule is bilocular. There are three ſpecies, viz. The americana, a native of Canada and Virginia; the aſiatica, a native of Ceylon and China; and the Africana, a native of Æthiopia.

BUCHAW, an imperial city of Swabia, in Germany, about twenty-five miles ſouth-weſt of Ulm: E. long. 9° 40′, and N. lat. 48° 5′.

BUCHAREST, a town of Wallachia, ſubject to the Turks: E. lon. 26° 30′, and N. lat. 44° 20′.

BUCHORN, a city of Swabia, in Germany, ſituated on the eaſt ſide of the lake of Conſtance, and about twelve miles eaſt of the city of Conſtance: E. long. 9° 20′, and N. lat. 47° 40′.

BUCIOCHE, in commerce, a ſort of woolen cloth manufactured in Provence, which the French ſhips carry to Alexandria and Cairo.

BUCK, in zoology. See Cervus.

Buck-bean, in botany. See Menyanthes.

Buck-thorn, the Engliſh name of the rhamnus.

Buck-wheat. See Polygonum.

BUCKET, a ſmall portable veſſel, to hold water, often made of leather for its lightneſs and eaſy uſe in caſes of fire.

It is alſo the veſſel let down into a well, or the ſides of ſhips, to fetch up water.

BUCKING, the firſt operation in the whitening of linnen yarn or cloth. See p. 564.

BUCKINGHAM, a borough-town of Buckinghamſhire, about forty-ſix miles north-weſt of London: W. lon. 1°, and N. lat. 51°. 50′.

It ſends two members to parliament.

Buckinghamſhire has Northamptonſhire on the north; Bedford, Hertford, and Middleſex, on the eaſt; Berkſhire, from which it is divided by the river Thames, on the ſouth; and Oxfordſhire, on the weſt.

BUCKLE, a well known utenſil, made of divers ſorts of metals, as gold, ſilver, ſteel, braſs, *&c.*

The faſhion or form of buckles is various; but their uſe, in general, is to make faſt certain parts of dreſs, as the ſhoes, garters, *&c.*

Buckles for girdles pay a duty of 3 s. $10\frac{20}{100}$ d. the groſs, or twelve dozen; whereof 1 s. $4\frac{1}{2}$ d. is drawn back on exportation. Buckles for girts pay likewiſe a duty of 1 s. $5\frac{32}{100}$ d. the groſs; and both theſe pay ſomewhat more, if of braſs. But it is be obſerved, that all buckles are prohibited to be imported.

BUCKLER, a piece of defenſive armour uſed by the ancients. It was worn on the left arm, and compoſed of wickers woven together, or wood of the lighteſt ſort, but moſt commonly of hides, fortified with plates of braſs or metal. The figure was ſometimes round, ſometimes oval, and ſometimes almoſt ſquare. Moſt of the bucklers were curiouſly adorned with all ſorts of figures of birds and beaſts, as eagles, lions; nor of theſe only, but of the gods, of the celeſtial bodies, and all the works of nature; which cuſtom was derived from the heroic times, and from them communicated to the Grecians, Romans, and Barbarians.

Votive BUCKLERS. Thoſe conſecrated to the gods, and hung up in their temples, either in commemoration of ſome hero, or as a thankſgiving for a victory obtained over an enemy; whoſe bucklers, taken in war, were offered as a trophy.

BUCKNHAM, or BUCKENHAM, a market-town of Norfolk, about nine miles eaſt of Thetford: E. long. 1° 10′, N. lat. 52° 30′.

BUCKOR, a province of the E. Indies, ſituated on the river Indus, having the province of Multan on the north, and Tatta on the ſouth.

BUCKRAM, in commerce, a ſort of coarſe cloth made of hemp, gummed, calendered, and dyed ſeveral colours. It is put into thoſe places of the lining of a garment, which one would have ſtiff, and to keep their forms. It is alſo uſed in the bodies of womens gowns; and it often ſerves to make wrappers to cover cloths, ſerges, and ſuch other merchandiſes, in order to preſerve them and keep them from the duſt, and their colours from fading. Buckrams are ſold wholeſale by the dozen of ſmall pieces or remnants, each about four ells long, and broad according to the pieces from which they are cut. Sometimes they uſe new pieces of linen cloth to make buckrams, but moſt commonly old ſheets and old pieces of ſails.

Carrick buckrams pays a duty of $5\frac{74}{100}$ d. the ſhort piece; whereof $5\frac{37}{100}$ d. is repaid on exporting it. Eaſt-country buckram pays 1 s. $2\frac{36}{100}$ d. the roll or half-piece; whereof 1 s. $\frac{93}{100}$ d. is drawn back. French buckram pays 1 l. 13 s. $10\frac{12}{100}$ d. the dozen pieces; whereof 1 l. 00 s. $1\frac{87}{100}$ d. is repaid. Fine German buckrams pays 2 s. $4\frac{72}{100}$ d. the piece; whereof 2 s. $1\frac{87}{100}$ d. is drawn back on exportation.

BUCKSTALL, a toil to take deer, which muſt not be kept by any body that has not a park of his own, under penalties.

BUCOLIC, in ancient poetry, a kind of poem relating to ſhepherds and country affairs, which, according to the moſt generally received opinion, took its riſe in Sicily. Bucolics, ſays Voſſius, have ſome conformity with comedy. Like it, they are pictures and imitations of ordinary life; with this difference, however, that comedy repreſents the manners of the inhabitants of cities, and bucolics the occupations of country people. Sometimes, continues he, this laſt poem is in form of a monologue, and ſometimes of a dialogue. Sometimes there is action in it, and ſometimes only narration; and ſometimes it is compoſed both of action and narration. The hexameter verſe is the moſt proper for bucolics in the Greek and Latin tongues. Moſchus, Bion, Theocritus, and Virgil, are the moſt renowned of the ancient bucolic poets.

BUD, among gardeners, that part of a ſeed which firſt begins to ſprout, or rather the leaves firſt put forth: Theſe in ſome plants are two; in others, four; and in others again, ſix, or even more.

BUD is alſo uſed for the ſprout from whence a branch ariſes.

BUD, in country-affairs, likewiſe denotes a weaned calf of the firſt year; ſo called, becauſe the horns are then in the bud.

BUDA, the capital of lower Hungary, about 130 miles ſouth-eaſt of Vienna: It ſtands on the ſide of a hill, on the ſouth-weſt ſide of the Danube, and is well fortified and defended by a caſtle, eſteemed one of the ſtrongeſt fortreſſes in Hungary: E. long. 19° 20′, N. lat. 52° 25′.

BUDDESDALE, a market-town of Suffolk, about thirteen miles north-eaſt of Bury: E. long. 1° 10′, and N. lat. 52° 25′.

BUDDLE, in mineralogy, a large ſquare frame of boards, uſed in waſhing the tin ore. See WASHING.

BUDDLEIA, in botany, a genus of the tetrandria monogynia claſs. The calix and corolla are each divided into four parts; the ſtamina are inſerted into the receptacle; the capſule has four cells, and contains many ſeeds. The ſpecies are two, *viz.* the occidentalis, and americana, both natives of America.

BUDDLING, the act of cleanſing, or waſhing any ore. See WASHING.

BUDGE-*barrels*, among engineers, ſmall barrels well hooped, with only one head; on the other end is nailed a piece of leather, to draw together upon ſtrings like a purſe. Their uſe is for carrying powder along with

with a gun or mortar, being leſs dangerous, and eaſier carried, than whole barrels. They are likewiſe uſed upon a battery of mortars, for holding meal-powder.

BUDINGEN, the capital of a county of the ſame name in Germany, ſituated in the circle of the upper Rhine, about twenty miles north-eaſt of Frankfort.

BUDOA, a city of Dalmatia, ſituated on the gulf of Venice, in 19° 20′ E. long. and 42° 15′ N. lat. It is a biſhop's ſee.

BUDWEIS, a town of Bohemia, ſituated on the river Muldaw, about ſixty-five miles ſouth of Prague: E. long. 14° 20′, N. lat. 49°.

BUDZIAC TARTARY, a country ſubject to the Turks; ſituated on the rivers Neiſter, Bog, and Nieper; having Poland and Ruſſia, on the north; Little Tartary, on the eaſt; the Black-ſea, on the ſouth; and Beſſarabia, on the weſt.

BUEN-AYRE. See BONAIRE.

BUENOS-AYRES, one of the moſt conſiderable Spaniſh ports on the eaſt coaſt of South America, ſituated on the ſouthern ſhore of the river Plata, and about fifty leagues from its mouth; and yet here the river is full ſeven leagues broad: W. long. 60°, S. lat 36°. It is a ſtrong fortified town

BUEN-RETIRO, a palace near Madrid, belonging to the king of Spain.

BUFF, in commerce, a ſort of leather prepared from the ſkin of the buffalo, which, dreſſed with oil, after the manner of ſhammy, makes what we call buff-ſkin. This makes a very conſiderable article in the French, Engliſh, and Dutch commerce at Conſtantinople, Smyrna, and all along the coaſt of Africa. The ſkins of elks, oxen, and other-like animals, when prepared after the ſame manner as that of the buffalo, are likewiſe called buffs.

Of buff-ſkin, or buff-leather, are made a ſort of coats for the horſe or gens d'arms of France, bandaliers, helts, pouches and gloves.

In France, there are ſeveral manufactories deſigned for the dreſſing of thoſe ſort of hides, particularly at Corbeil, near Paris; at Niort, at Lyons, at Rone, at Etanepus, at Cone.

BUFFALO, in zoology. See BOS.

BUFFET was anciently a little apartment, ſeparated from the reſt of the room by ſlender wooden columns, for the diſpoſing of china, glaſs-ware, *&c.*

It is now properly a large table in a dinning-room, called alſo a ſide-board, for the plate, glaſſes, bottles, baſons, *&c.* to be placed on, as well for the ſervice of the table, as for magnificence. In houſes of perſons of diſtinction in France, the buffet is a detached room, decorated with pictures relative to the ſubject, with fountains, ciſterns and vaſes. It is commonly faced with marble or bronze.

BUFFOON, a droll or mimic who diverts the public by his pleaſantries and follies.

BUFO, in zoology, the trivial name of a ſpecies of rana. See RANA.

BUFONIA, in botany, a genus of the diandria monogynia claſs. The calix is four-leaved; the petals are four; and the capſule is unilocular, and contains two ſeeds. There is but one ſpecies, *viz.* the tenuifolia or baſtard chick-weed, a native of Britain.

BUG, a river, which, taking its riſe in red Ruſſia in Poland, runs norhward to Breſte; and then, turning weſtward, falls into the Weiſel, or Viſtula, below Warſaw.

BUG, or BUGG, in zoology, the Engliſh name of a ſpecies of cimex. See CIMEX.

BUGEN, a town of Japan, the capital of the kingdom of that name, in the iſle of Ximo.

BUGEY, a territory in France, being the ſouth diviſion of Breſſe; in Burgundy, on the frontiers of Savoy.

BUGGASINS, in commerce, a name given to buckrams made of callico: theſe pay a duty, on importation, of 1 s. $2\frac{36}{100}$d. the half piece; whereof 1 s. $\frac{93}{100}$d. is drawn back on exportation.

BUGGERS, in church-hiſtory, the ſame with bulgarians, a ſect of heretics which, amongſt other errors, held, that men ought to believe no ſcripture but the New Teſtament; that baptiſm was not neceſſary to infants; that huſbands who converſed with their wives could not be ſaved; and that an oath was abſolutely unlawful.

BUGGERER, a perſon who is guilty of the crime of buggery. See the next article.

BUGGERY, is defined by Sir Edward Coke to be a carnal copulation againſt nature, either by the confuſion of ſpecies, that is to ſay, a man or woman with a brute beaſt; or ſexes, as a man with a man, or man unnaturally with a woman. It is ſaid this ſin againſt God and nature was firſt brought into England by the Lombards; and anciently, according to ſome writers, it was puniſhable with burning; but others ſay, with burying alive. It is, by ſtatute, felony without benefit of clergy, and is always excepted out of a general pardon.

BUGIA, a port-town of the kingdom of Algiers, in Africa, ſituated about ſixty miles eaſt of the city of Algiers; E. long. 4°, N. lat. 35° 30′.

BUGIE, a port-town of Egypt, ſituated on the weſtern ſhore of the Red-ſea, almoſt oppoſite to Ziden, the port-town to Mecca, and about 100 miles weſt of it; E. long. 36°, N. lat. 22°.

BUGLE, in botany. See ADJUGA.

BUGLOSS, in botany. See ANCHUSA.

Viper's BUGLOSS, in botany. See ECHIUM.

BUGULA, BUGLE, in botany. See ADJUGA.

BUHL, a little fortreſs in Swabia, about ſix miles ſouth-eaſt of Stolhoffen, and nineteen north-eaſt of Straſburg.

BUILDING, a fabric erected by art, either for devotion, for magnificence, or for conveniency.

Regular BUILDING, is that whoſe plan is ſquare, the oppoſite ſides equal, and the parts diſpoſed with ſymmetry.

Irregular BUILDING, that whoſe plan is not contained with equal or parallel lines, either by the accident of ſituation, or the deſign of the builder, and whoſe parts are not relative to one another in the elevation.

Inſulated

Insulated BUILDING, that which is not contiguous to any other, but is encompassed with streets, open squares, or the like.

Engaged BUILDING, one surrounded with other buildings, having no front to any street or public place, nor any communication without, but by a common passage.

Interred or sunk BUILDING, one whose area is below the surface of the place on which it stands, and of which the lowest courses of stone are concealed.

BUILDING is also used for the art of constructing and raising an edifice; in which sense it comprehends as well the expences, as the invention and execution of the design.

As for the materials of buildings, they are either stone, as marble, free-stone, brick for the walls, mortar, *&c.* or of wood, as fir, cypress, cedars for pillars of upright uses, oak for summers, beams, and crop-work, or for joining and connection. See ARCHITECTURE.

BUL, in the ancient Hebrew chronology, the eighth month of the ecclesiastical, and the second of the civil year; it has since been called Marshevan, and answers to our October.

BULAC, a town of Egypt, situated on the eastern shore of the river Nile, about two miles west of Grand Cairo, of which it is the port-town, and contains about four thousand families; E. long. 32°, and N. lat. 30°.

It is a place of great trade, as all the vessels going up and down the Nile make some stay here: it is also in this place that they cut the banks of the Nile every year, in order to fill their canals, and overflow the neighbouring grounds, without which the soil would produce neither grain nor herbage.

BULAFO, a musical instrument consisting of several pipes of wood, tied together with thongs of leather so as to form a small interstice between each pipe. It is used by the negroes of Guinea.

BULB, or BULBOUS ROOT, in the anatomy of plants, expresses a root of a round or roundish figure, and usually furnished with fibres at its base.

Bulbous roots are said to be solid, when composed of one uniform lump of matter; tunicated, when formed of multitudes of coats, surrounding one another; squamose, when composed of, or covered with lesser flakes; duplicate, when there are only two to each plant; and aggregate, when there is a congeries of such roots to each plant.

BULBOCASTANUM, in botany. See BUNIUM.

BULBOCODIUM, in botany, a genus of the hexandria monogynia class. The corolla is shaped like a tunnel, and consists of five petals; the claws of the petals are narrow. There is but one species, *viz.* the vernum, a native of Spain.

BULBOSE. See BULB.

BULEUTÆ, in Grecian antiquity, were magistrates answering to the decuriones among the Romans. See DECURIO.

BULGAR, the capital of the province of Bulgar, in Russia, situated on the river Wolga; E. long. 51°, and N. lat. 54°.

BULGARIA, a province of Turky in Europe, bounded by the river Danube, which divides it from Wallachia and Moldavia on the north, by the Black Sea on the east, by Romania on the south, and by Servia on the west. Its chief city is Nicopolis.

BULGARIAN *language*, the same with the Sclavonic.

BULIMY, a disease in which the patient is affected with an insatiable and perpetual desire of eating; and, unless he is indulged, he often falls into fainting fits. It is also called *fames canina*, canine appetite.

BULITHUS, a stone found either in the gall-bladder, or in the kidneys and bladder of an ox. See BOS.

BULK *of a ship*, the whole content in the hold for the stowage of goods.

BULK-HEADS are partitions made athwart the ship with boards, by which one part is divided from the other; as the great cabbin, gun-room, bread-room, and several other divisions. The bulk-head afore is the partition between the fore-castle and gratings in the head.

BULL, in zoology. See BOS.

BULL, in astronomy. See ASTRONOMY, p. 486, 487.

BULL'S-EYE, among seamen, a small, obscure, sublime cloud, ruddy in the middle, that sometimes appears to mariners, and is the immediate forerunner of a great storm at sea.

BULL-FINCH, in ornithology. See LOXIA.

BULL-FROG, in zoology, See RANA.

BULL-HEAD, in ichthyology. See COTTUS.

BULL, among ecclesiastics, a written letter, dispatched, by order of the pope, from the Roman chancery, and sealed with lead, being written on parchment, by which it is partly distinguished from a brief. See the article BRIEF.

It is a kind of apostolical rescript, or edict, and is chiefly in use in matters of justice or grace. If the former be the intention of the bull, the lead is hung by a hempen cord; if the latter, by a silken thread. It is this pendent lead, or seal, which is, properly speaking, the bull, and which is impressed, on one side, with the heads of St. Peter and St. Paul, and on the other with the name of the pope and the year of his pontificate. The bull is written in an old, round, gothic letter, and is divided into five parts, the narrative of the fact, the conception, the clause, the date, and the salutation, in which the pope styles himself *servus servorum*, i. e. the servant of servants.

These instruments, besides the lead hanging to them, have a cross, with some text of scripture, or religious motto, about it. Bulls are granted for the consecration of bishops, the promotion to benefices, and the celebration of jubilees, *&c.*

BULL *in cœna Domini*, a particular bull read every year, on the day of the Lord's supper, or Maundy Thursday, in the pope's presence, containing excommunications and anathemas against heretics, and all who disturb or oppose the jurisdiction of the holy see.

After the reading of the bull, the pope throws a burning torch into the public place, to denote the thunder of this anathema.

Golden Bull, an edict, or imperial constitution, made by the emperor Charles IV. reputed to be the magna charta, or the fundamental law of the German empire.

It is called golden, becaufe it has a golden feal, in the form of a pope's bull, tied with yellow and red cords of filk: upon one fide is the emperor reprefented fitting on his throne, and on the other the capitol of Rome. It is alfo called Caroline, on Charles IV's account. Till the publication of the golden bull, the form and ceremony of the election of an emperor were dubious and undetermined, and the number of the electors not fixed. This folemn edict regulated the functions, rights, privileges, and pre-eminences of the electors. The original, which is in Latin, on vellum, is preferved at Frankfort: this ordonnance, containing thirty articles, or chapters, was approved of by all the princes of the empire, and remain ftill in force.

BULLA, in zoology, a genus belonging to the order of vermes teftaceæ. It is an animal of the fnail-kind: The fhell confifts of one valve, convoluted, and without any prickles; the aperture is narrowifh, oblong, longitudinal, and entire at the bafe; the columella is fmooth and oblique. There are twenty-three fpecies, moft of them natives of the Afiatic and Atlantic oceans.

BULLÆ, in Roman antiquity, ornaments at firft given only to the fons of noblemen; though afterwards they became of more common ufe. This ornament was firft given by Tarquinius with the prætexta to his fon, who had, with his own hand, at fourteen years of age, killed an enemy. Thus we find the bulla was a fign of triumph. Macrobius relates, that the children of freed men were allowed to wear the prætexta, and, inftead of the golden bulla, a leathern one, about their necks: Thofe bullæ were made hollow within to inclofe amulets againft envy, *&c.* When the youth arrived at fifteen years of age, they hung up their bullæ about the necks of their gods lares. We are farther informed, that the bullæ were not only hung about the necks of young men, but of horfes alfo.

BULLEN, a term ufed by country people for hemp-ftalks peeled.

BULLET, an iron or leaden ball, or fhot, wherewith fire-arms are loaded. See Ball.

BULLINGBROKE, in geography. See Bolingbrook.

BULLION, uncoined gold or filver in the mafs.

Thofe metals are called fo, either when fmelted from the native ore, and not perfectly refined; or when they are perfectly refined, but melted down in bars or ingots, or in any unwrought body, of any degree of finenefs.

When gold and filver are in their purity, they are fo foft and flexible, that they cannot well be brought into any fafhion for ufe, without being firft reduced and hardened with an alloy of fome other bafer metal. To prevent thefe abufes, which fome might be tempted to commit in the making of fuch alloys, the legiflators of civilized countries have ordained, that there fhall be no more than a certain proportion of a bafer metal to a particular quantity of pure gold or filver, in order to make them of the finenefs of what is called the ftandard gold or filver of fuch a country.

According to the laws of England, all forts of wrought plate in general, ought to be made to the legal ftandard; and the price of our ftandard gold and filver is the common rule whereby to fet a value on their bullion, whether the fame be in ingots, bars, duft, or in foreign fpecie: whence it is eafy to conceive that the value of bullion cannot be exactly known, without being firft affayed, that the exact quantity of pure metal therein contained may be determined, and confequently whether it be above or below the ftandard.

Silver and gold, whether coined or uncoined, (tho' ufed for a common meafure of other things), are no lefs a commodity, than wine, tobacco, or cloth; and may, in many cafes, be exported as much to the national advantage as any other commodity.

BULLOCK, the fame with an ox, or gelded bull. See Bos.

BULLY-tree, in botany. See Chrysophyllum.

BULTEL, a term ufed to denote the refufe of meal after dreffing, or the cloth wherein it is dreffed, otherwife called bulter-cloth.

BULWARK, in the ancient fortification. See Rampart.

BUMICILLI, a religious fect of Mahometans in Egypt and Barbary, who pretend to fight with devils, and commonly appear in a fright and covered with wounds and bruifes. About the full moon they counterfeit a combat in the prefence of all the people, which lafts for two or three hours, and is performed with affagaias, or javelins, till they fall down quite fpent; in a little time, however, they recover their fpirits, get up, and walk away.

BUNGAY, a market-town of Suffolk, fituated on the river Wavenny, about thirty-two miles north-eaft of Bury: E. lon. 1° 35′, and N. lat. 52° 35′.

BUNGO, or Bongo. See Bongo.

BUNIAS, in botany, a genus of the tetradynamia filiquofa clafs. The pod is deciduous, quadrangular, and the angles are unequal and terminate in fharp points. There are four fpecies, only one of which, viz. the cakile, or fea-rocket, is a native of Britain.

BUNDLE, a collection of things wrapped up together. Of bafte-ropes, harnefs-plates, and glover's knives, ten make a bundle; of hamburg yarn, twenty fkeans; of bafket-rods, three feet about the band.

BUNIUM, in botany, a genus of the pentandria digynia clafs. The corolla is uniform; the umbella is thick; and the fruit is oval. There is but one fpecies, viz. the bulbocaftanum, earth-nut, kipper-nut, pig-nut, or hawk-nut, a native of Britain.

BUNK, or Bunken, in the materia medica. See Leucacantha.

BUNT *of a fail*, the middle part of it, formed defignedly into a bag or cavity, that the fail may gather more

more wind. It is ufed moftly in top-fails, becaufe courfes are generally cut fquare, or with but fmall allowance for bunt or compafs. The bunt holds much leeward wind, that is, it hangs much to leeward.

BUNT-LINES are fmall lines made faft to the bottom of the fails, in the middle part of the bolt-rope, to a cringle, and fo are reeved through a fmall block, feized to the yard. Their ufe is to trice up the bunt of the fail, for the better furling it up.

BUNTING, in ornithology, the Englifh name of a fpecies of fringilla. See FRINGILLA.

BUNTINGFORD, a market town of Hertfordfhire, about twelve miles north of Hertford: W. long. 5′, and N. lat. 51° 55′.

BUNTZLAU, or BUNTZEL, the name of two towns in Germany: the old town is fituated on the river Elbe, and new town, which is become the moft confiderable, upon the Gizare, eight leagues from Lignitz, in 16° 26′ E. long. and 51° 12′ N. latitude. There is likewife a town of that name in Silefia.

BUONO, as TEMPO-BUONO, in mufic, fignifies a certain time or part of the meafure, more proper for certain things than any other, as to end a cadence or paufe, to place a long fyllable or fyncoped diffonance, concord, *&c.* In common time of four times to a bar, the firft and third is one buono tempo, as the fecond and laft are called *tempo di cattiva.*

BUOY, at fea, a fhort piece of wood, or a clofe-hooped barrel, faftened fo as to float directly over the anchor, that the men, who go in the boat to weigh the anchor, may know where it lies.

BUOY is alfo a piece of wood, or cork, fometimes an empty cafk, well clofed, fwimming on the furface of the water, and faftened, by a chain or cord, to a large ftone, piece of broken cannon, or the like, ferving to mark the dangerous places near a coaft, as rocks, fhoals, wrecks of veffels, anchors, *&c.*

There are fometimes, inftead of buoys, pieces of wood placed in form of mafts, in confpicuous places; and fometimes large trees are planted in a particular manner, in number two at leaft, to be taken in a right line, the one hiding the other, fo as the two may appear to the eye no more than one.

Stream the BUOY is to let the anchor fall while the fhip has way.

To BUOY *up the cable* is to faften fome pieces of wood, barrels, *&c.* to the cable, near the anchor, that the cable may not touch the ground, in cafe it be foul or rocky, left it fhould be fretted and cut off.

BUOYANT, fomething which, by its aptnefs to float, bears up other more ponderous and weighty things. See BUOY.

BUPHAGA, in ornithology, a genus belonging to the order of picæ. The beak is ftreight and quadrangular; the mandibles are gibbous, entire, and the gibbofity is greater on the outfide. The feet are of the ambulatory kind. The body is greyifh above, and of a dirty yellow below; the tail is fhaped like a wedge. It is a native of Senegal; and frequently perches upon oxen, and picks out the worms from their backs.

BUPHTHALMUM, a genus of the fyngenefia polygamia fuperflua clafs. The receptacle is paleaceous; the margin of the pappus is obfolete; the fides of the feeds are marginated; and the ftigmata of the hermaphrodite flofcules are undivided. The fpecies are ten, none of which are natives of Britain.

BUPLEURUM, in botany, a genus of the pentandria digynia clafs. The involucrum of the umbells is large and five-leaved; the fruit is ftriated, compreffed, and roundifh. The fpecies are feventeen, only two of which are natives of Britain, *viz.* the rotundifolium, or thorow-wax; and the tenuiffimum, or the leaft hare's-ear.

BUPRESTIS, in zoology, a genus of infects belonging to the order of coleoptera. The feelers are like briftles, and about the length of the breaft; the lead is half retracted into the thorax. There are twenty-feven fpecies of this infect, moft of them natives of the Indies.

BUQUOI, a town of Artois, in the French Netherlands, fituated on the confines of Picardy: E. long. 2° 40′, and N. lat. 50° 12′.

BUR, a broad ring of iron, behind the place made for the hand on the fpears ufed formerly in tilting, which bur was brought to reft, when the tilter charged his fpear.

BURBAS, in commerce, a fmall coin at Algiers, with the arms of the dey ftruck on both fides: it is worth half an afper.

BURCHAUSEN, a town of Germany, in the lower Bavaria, fituated on the river Saltz: E. long. 13° 25′, and N. lat. 48° 5′.

BURDEN, or BURDON, in mufic, the drone or bafs, and the pipe or ftring which plays it: Hence that part of a fong, that is repeated at the end of every ftanza, is called the burden of it.

A chord which is to be divided, to perform the intervals of mufic, when open and undivided, is alfo called the burden.

BURDEN *of a fhip* is its contents, or number of tons it will carry. The burden of a fhip may be determined thus: multiply the length of the keel, taken within board, by the breadth of the fhip, within board, taken from the midfhip-beam, from plank to plank, and multiply the product by the depth of the hold, taken from the plank below the keelfon, to the under part of the upper deck plank, and divide the laft product by 94, then the quotient is the content of the tonnage required. See FREIGHT.

BURDO, that kind of mule produced between a horfe and a fhe-afs. See MULE.

BURDOCK, in botany, the Englifh name of the xanthium. See XANTHIUM.

BURDUGNO, a town of the Morea, fituated on the river Vafilipotomo, near Mifitra.

BUREN, a town of Dutch Guelderland, about fixteen miles weft of Nimeguen: E. long. 5° 20′, and N. lat. 52°.

BUREN is alfo the name of a town in Weftphalia in Germany, about five miles fouth of the city of Paderborn: E. long. 8° 25′, and N. lat. 51° 35′.

BURFORD, a market-town of Oxfordfhire, about fifteen

teen miles weſt of Oxford: W. long. 1° 40′, N. lat. 51° 40′.

It gives the title of earl to the noble family of Beauclerc.

BURG, a town of Zutphen, in the Dutch Netherlands, ſituated upon the Old Iſſel, about eighteen miles eaſt of Nimeguen: E. long. 6° 10′, and N. lat. 52°.

BURGA, a cape of Algiers in Africa, running out into the Med terranean ſea.

BURGAGE, an ancient tenure in boroughs, whereby the inhabitants, by cuſtom, hold their lands, *&c.* of the king, or other ſuperior lord of the borough, at a certain yearly rent: Alſo a dwelling-houſe in a borough, was anciently called a burgage.

BURGEON, a term uſed by gardeners in the ſame ſenſe with bud. See BUD.

BURGESS, an inhabitant of a borough, or one who poſſeſſes a tenement therein.

In other countries, burgeſs and citizen are confounded together; but with us they are diſtinguiſhed: The word is alſo applied to the magiſtrates of ſome towns.

Burgeſs is now ordinarily uſed for the repreſentative of a borough-town in parliament.

BURGGRAVE properly denotes the hereditary governor of a caſtle or fortified town, chiefly in Germany.

BURGH, See BOROUGH.

BURGH-*bote* ſignifies a contribution towards the building or repairing of caſtles, or walls, for the defence of a borough, or city.

BURGH-*breche* is properly the breaking open a burgh, houſe, incloſure, *&c.* and in the laws of Canute, cap. lv. ſignifies a fine impoſed upon a community of a town for a breach of the peace. According to Raſtallus, burgh-breche is, to be quit of treſpaſſes committed againſt the peace, in city or borough.

BURGHERMESTERS. See BURGOMASTER.

BURGHMASTER, among miners. See BARMASTER.

BURGHMOTE, the court of a borough.

BURGLARY, a felonious breaking and entering into the dwelling-houſe of another perſon in the nighttime, with an intent to commit ſome felony, whether the ſame be executed, or not.

The like offence committed by day, is called houſe-breaking.

Burglary is an offence excluded the benefit of clergy, and may be committed by taking away goods from a dwelling-houſe, any perſon being therein; or breaking any ſhop, warehouſe, *&c.* though in the day-time, and taking goods from thence of five ſhillings value, if no perſon be therein.

BURGLES, a town of Tranſilvania, about thirty miles north of Clauſenburg, ſubject to the houſe of Auſtria: E. long. 22° 40′, and N. lat. 47° 40′.

BURGOMASTER, the chief magiſtrate of the great towns in Flanders, Holland, and Germany. The power and juriſdiction of the burgomaſter is not the ſame in all places, every town having its particular cuſtoms and regulations: At Amſterdam there are four choſen by the voices of all thoſe people in the ſenate, who have either been burgomaſters or echevins. Their authority reſembles that of our lord-mayor and aldermen; they diſpoſe of all under-offices that fall in their time, keep the key of the bank, and enjoy a ſalary but of five hundred guilders, all feaſts, public entertainments, *&c.* being defrayed out of the common treaſury.

BURGOO, a diſh frequent at ſea, being made of oatmeal, or greets, boiled in water till they burſt, and then ſome butter added.

BURGOS, the capital of Old Caſtile in Spain, about one hundred and ten miles north of Madrid: W. long. 4° 5′, and N. lat. 42° 30′.

BURGOW, a town of Swabia in Germany, about twenty miles weſt of Augſburg: E. long. 10° 20′, N. lat. 48° 30′.

BURGUNDY, or BURGOGNE, a province or government in France, having Champaign on the north, and Dauphine on the ſouth.

BURIAL, the interment of a deceaſed perſon.

The rites of burial are looked upon in all countries, and at all times, as a debt ſo ſacred, that ſuch as neglected to diſcharge it were thought accurſed: Hence the Romans called them *juſta*, and the Greeks [*nomima*, *dikaia*, *hoſia*,] &c. words implying the inviolable obligations which nature has laid upon the living to take care of the obſequies of the dead. Nor are we to wonder, that the ancient Greeks and Romans were extremely ſolicitous about the interment of their deceaſed friends, ſince they were ſtrongly perſuaded, that their ſouls could not be admitted into the Elyſian fields till their bodies were committed to the earth; and if it happened that they never obtained the rites of burial, they were excluded from the happy manſions for the term of an hundred years. For this reaſon it was conſidered as a duty incumbent upon all travellers who ſhould meet with a dead body in their way, to caſt duſt or mould upon it three times, and of theſe three handfuls, one at leaſt was caſt upon the head. The ancients likewiſe conſidered it as a great misfortune if they were not laid in the ſepulchres of their fathers; for which reaſon, ſuch as died in foreign countries had uſually their aſhes brought home, and interred with thoſe of their anceſtors. But notwithſtanding their great care in the burial of the dead, there were ſome perſons whom they thought unworthy of that laſt office, and to whom therefore they refuſed it: Such were, 1. Public or private enemies. 2. Such as betrayed, or conſpired againſt their country. 3. Tyrants, who were always looked upon as enemies to their country. 4. Villains guilty of ſacrilege. 5. Such as died in debt, whoſe bodies belonged to their creditors. And, 6. Some particular offenders, who ſuffered capital puniſhment.

Of thoſe who were allowed the rites of burial, ſome were diſtinguiſhed by particular circumſtances of diſgrace attending their interment: Thus perſons killed by lightening were buried apart by themſelves, being thought odious to the gods; thoſe who waſted their patrimony, forfeited the right of being buried in the ſepulchres of their fathers; and thoſe who were guilty of

of self-murder were privately deposited in the ground, without the accustomed solemnities. Among the Jews, the privilege of burial was denied only to self-murderers, who were thrown out to rot upon the ground. In the Christian church, though good men always desired the privilege of interment, yet they were not, like the heathens, so concerned for their bodies, as to think it any detriment to them, if either the barbarity of an enemy, or some other accident, deprived them of this privilege. The primitive Christian church denied the more solemn rites of burial only to unbaptized persons, self-murderers, and excommunicated persons who continued obstinate and impenitent, in a manifest contempt of the church's censures.

The place of burial among the Jews was never particularly determined. We find they had graves in the town and country, upon the highways, in gardens, and upon mountains. Among the Greeks, the temples were made repositories for the dead in the primitive ages; yet the general custom in latter ages, with them, as well as with the Romans and other heathen nations, was to bury their dead without their cities, and chiefly by the highways. Among the primitive Christians, burying in cities was not allowed for the first three hundred years, nor in churches for many ages after, the dead bodies being first deposited in the atrium or church-yard, and porches and porticos of the church: hereditary burying-places were forbidden till the 12th century. As to the time of burial, with all the ceremonies accompanying it, see the article FUNERAL-RITES.

BURICK, a town of the duchy of Cleves, in the circle of Westphalia in Germany, situated on the river Rhine, about twenty miles south of Cleves: E. long. 6° 5′, N. lat. 51° 35′.

BURLESQUE, a species of composition, which, tho' a great engine of ridicule, is not confined to that subject; for it is clearly distinguishable into burlesque that excites laughter merely, and burlesque that excites derision or ridicule. A grave subject, in which there is no impropriety, may be brought down by a certain colouring so as to be risible, as in Virgil Travestie; the author first laughs at every turn, in order to make his readers laugh. The Lutrin is a burlesque poem of the other sort, laying hold of a low and trifling incident to expose the luxury, indolence, and contentious spirit of a set of monks. Boileau, the author, turns the subject into ridicule by dressing it in the heroic style; and affecting to consider it as of the utmost dignity and importance. Though ridicule is the poet's aim, he always carries a grave face, and never once bewrays a smile. The opposition between the subject and the manner of handling it, is what produces the ridicule; and therefore, in a composition of this kind, no image professedly ludicrous ought to have quarter, because such images destroy the contrast.

Though the burlesque that aims at ridicule, produces its effects by elevating the style far above the subject, yet the poet ought to confine himself to such images as are lively, and readily apprehended. A strained elevation, soaring above the ordinary reach of fancy, makes not a pleasant impression. The mind is soon disgusted by being kept long on the stretch. Machinery may be employed in a burlesque poem, such as the Lutrin, the Dispensary, or Hudibras, with more success and propriety than in any other species of poetry. For burlesque poems, though they assume the air of history, give entertainment chiefly by their pleasant and ludicrous pictures: It is not the aim of such a poem to raise sympathy; and for that reason, a strict imitation of nature is not necessary. And hence, the more extravagant the machinery in a ludicrous poem, the more entertainment it affords.

BURLINGTON, a sea-port town in the East Riding of Yorkshire, situated on the German ocean, about thirty-seven miles north-east of York: E. long. 10′, and N. lat. 54° 15′.

It gives the title of earl to a branch of the noble family of Boyle.

New BURLINGTON, the capital of New-Jersey, in North America; situated in an island of Delawar river, about twenty miles north of Philadelphia: W. long. 74°, and N. lat. 40° 40′.

BURMANNIA, in botany, a genus of the hexandria monogynia class. The calix is shaped like a prism, coloured and divided into three segments, with membranaceous angles; the petals are three; the capsule is three-celled; and the seeds are very small. There are only two species, none of them natives of Britain.

BURN, in medicine and surgery, an injury received in any part of the body by fire. See MEDICINE, and SURGERY.

BURNET, in botany. See POTERIUM, and SANGUISORBA.

BURNHAM, a market-town of Norfolk, about 25 miles north-west of Norwich: E. long. 50′, and N. lat. 53°.

BURNING, the action of fire on some pabulum, or fuel, by which the minute parts thereof are put into a violent motion, and some of them assuming the nature of fire themselves, fly off *in orbem*, while the rest are dissipated in form of vapour, or reduced to ashes. See FIRE.

BURNING, or BRENNING, in our old customs, denotes an infectious disease, got in the stews by conversing with lewd women, and supposed to be the same with what we now call the venereal disease.

In a manuscript of the vocation of John Bale to the bishopric of Ossory, written by himself, he speaks of Dr. Hugh Weston, who was dean of Windsor, in 1556, but deprived by cardinal Pole for adultery, thus: " At this day is leacherous Weston, who is more practised in the arts of breech-burning, than all the whores of the stews. He not long ago brent a beggar of St. Botolph's parish." See STEWS.

BURNING, in antiquity, a way of disposing of the dead, much practised by the ancient Greeks and Romans, and still retained by several nations in both the East and West Indies.

Eustathius assigns two reasons why burning came to be of so general use in Greece; the first is, because bodies were thought to be unclean after the soul's departure,

parture, and therefore were purified with fire. The ſecond reaſon is, that the ſoul, being ſeparated from the groſs and unactive matter, might be at liberty to take its flight into heaven. The body was rarely burnt without company, for beſides the various animals they threw upon the pile, we ſeldom find a man of quality conſumed without a number of ſlaves and captives, which, in barbarous times, they uſed to murder for that purpoſe: and in ſome parts of the Eaſt Indies it is cuſtomary, at this day, for wives to throw themſelves into the funeral pile with their deceaſed huſbands. At the funerals of emperors, generals, *&c.* who had their arms burnt with them, the ſoldiers made proceſſion three times round the funeral pile with ſhouts and trumpets, to expreſs their reſpect to the dead. During the burning alſo, the dead perſon's friends ſtood by, called on the deceaſed, and poured out libations of wine, with which, when the pile was burnt down, they extinguiſhed the remains of the fire; and having collected the bones of the deceaſed, waſhed them with wine, and anointed them with oil. When the bones were diſcovered, they gathered the aſhes that lay cloſe to them, and both were repoſited in urns, either of wood, ſtone, earth, ſilver, or gold, according to the quality of the deceaſed. See URN.

BURNING, among ſurgeons. See CAUTERIZATION.

Burning is much practiſed by the people of the Eaſt Indies, particularly thoſe of Japan, who uſe the moxa for this purpoſe. See MOXA.

BURNING-*glaſs*, a convex or concave glaſs, commonly ſpherical, which being expoſed directly to the ſun, collects all the rays falling thereon into a very ſmall ſpace, called the focus; where wood, or any other combuſtible matter being put, will be ſet on fire. See OPTICS.

BURNING-*mountains*. See VOLCANO.

BURNING *of colours*, among painters. There are ſeveral colours that require burning; as firſt, lamp-black, which is a colour of ſo greaſy a nature, that, except it is burnt, it will require a long time to dry.

The method of burning, or rather drying, lamp-black, is as follows: Put it into a crucible over a clear fire, letting it remain till it be red hot, or ſo near it that there is no manner of ſmoke ariſes from it.

Secondly, Umber, which if it be intended for colour for a horſe, or to be a ſhadow for gold, then burning fits it for both theſe purpoſes.

In order to burn umber, you muſt put it into the naked fire, in large lumps, and not take it out till it is thoroughly red hot; if you have a mind to be more curious, put it into a crucible, and keep it over the fire till it be red hot.

Ivory alſo muſt be burnt to make black, thus: fill two crucibles with ſhavings of ivory, then clap their two mouths together, and bind them faſt with an iron wire, and lute the joints cloſe with clay, ſalt, and horſe-dung, well beaten together; then ſet it over the fire, covering it all over with coals: let it remain in the fire, till you are ſure that the matter incloſed is thoroughly red hot: then take it out of the fire; but do not open the crucibles till they are perfectly cold; for were they opened while hot, the matter would turn to aſhes; and ſo it will be, if the joints are not luted cloſe.

BURNISHER, a round, poliſhed piece of ſteel, ſerving to ſmooth and give a luſtre to metals.

Of theſe there are different kinds of different figures, ſtrait, crooked, *&c.* Half burniſhers are uſed to ſolder ſilver, as well as to give a luſtre. See SOLDERING.

BURNISHING, the art of ſmoothing or poliſhing a metalline body, by a briſk rubbing of it with a burniſher.

Book-binders burniſh the edges of their books, by rubbing them with a dog's tooth. Gold and ſilver are burniſhed, by rubbing them with a wolf's tooth, or by the bloody ſtone, or by tripoli, a piece of white wood, emery, and the like. Deer are ſaid to burniſh their heads, by rubbing off a downy white ſkin from their horns, againſt a tree.

BURNLEY, a market-town of Lancaſhire, about 27 miles ſouth-eaſt of Lancaſter: W. long. 2° 5′, and N. lat. 53° 40′.

BURR, the round knob of a horn next a deer's head.

BURRE, BOUREE, or BOREE, a kind of dance compoſed of three ſteps joined together in two motions, begun with a crotchet riſing. The firſt couplet contains twice four meaſures, the ſecond twice eight. It conſiſts of a balance and coupee.

BURREGREG, a conſiderable river of the kingdom of Fez, in Africa; which taking its riſe in the Atlas mountains, falls into the ocean not far from the ſtraits of Gibraltar.

BURR-PUMP, or BILDGE-PUMP, differs from the common pump, in having a ſtaff 6, 7, or 8 feet long, with a bar of wood, whereto the leather is nailed, and this ſerves inſtead of a box: So two men, ſtanding over the pump, thruſt down this ſtaff, to the middle whereof is faſtened a rope, for 6, 8, or 10 to hale by, thus pulling it up and down.

BURROCK, a ſmall wier or dam, where wheels are laid in a river, for the taking of fiſh.

BURROW, or BOROUGH. See BOROUGH.

BURROWS, holes in a warren, which ſerve as a covert for hares, rabbits, *&c.*

BURSA, or PRUSA, in geography, the capital of Bithinia, in Aſia Minor, ſituated in a fine fruitful plain, at the foot of mount Olympus, about an hundred miles ſouth of Conſtantinople: E. long. 29°, and N. lat. 40° 30′.

BURSA-*paſtoris*, in botany. See THLASPI.

BURSAR, in a general ſenſe, ſignifies a treaſurer or purſe-keeper, eſpecially in a monaſtery.

BURSE, in a commercial ſenſe, a place for merchants to meet in, and negotiate their buſineſs publicly, with us called exchange. See EXCHANGE.

BURSTEN, denotes a perſon who has a rupture. See RUPTURE.

BURTON, in geography, the name of two market-towns, the one in Staffordſhire, and the other in Lincolnſhire; the former being ſituated about 18 miles eaſt of Stafford, in 1° 36′ W. long. and 52° 40′ N. lat.

N. lat. and the latter, thirty miles north of Lincoln, in 30° W. long. and 53° 40′ N. lat.

Burton is alfo the name of a market-town in Weftmoreland, about thirty miles fouth-weft of Appleby: W. long. 2° 35′, N. lat. 54° 10′.

Burton, in the fea-language, a fmall tackle confifting of two fingle blocks, and may be made faft any where at pleafure, for hoifting fmall things in and out; and will purchafe more than a fingle tackle with two blocks.

BURY, in geography, a market-town of Lancafhire, about 30 miles fouth-eaft of Lancafter: W. long. 2° 20′, N. lat. 53° 36′.

Bury St Edmunds, or St Edmund's Bury, the county-town of Suffolk, about twelve miles eaft of Newmarket, and feventy north-eaft of London: E. long. 45′, N. lat. 52° 20′.

Bury is alfo a term fometimes ufed for the hole or den of fome animal under ground, more ufually called burrow.

Thus we fay, the bury of a mole, rabbit, *&c.*

BUSH, a term ufed for feveral fhrubs of the fame kind growing clofe together: thus we fay, a furze-bufh, bramble-bufh, *&c.*

Bush is fometimes ufed, in a more general fenfe, for any affemblage of thick branches interwoven and mixed together.

Burning-Bush, that bufh wherein the Lord appeared to Mofes at the foot of mount Horeb, as he was feeding his father-in-law's flocks.

As to the perfon that appeared in the bufh, the text fays, "That the angel of the Lord appeared unto him in a flame of fire, out of the middle of the bufh:" but whether it was a created angel, fpeaking in the perfon of God, or God himfelf, or (as the moft received opinion is) Chrift the Son of God, has been matter of fome controverfy among the learned. Thofe who fuppofe it no more than an angel, feem to imply that it would be a diminution of the majefty of God, to appear upon every occafion, efpecially when he has fuch a number of celeftial minifters, who may do the bufinefs as well. But confidering that God is prefent every where, the notification of his prefence by fome outward fign in one determinate place, (which is all we mean by his appearance), is in our conception lefs laborious (if any thing laborious could be conceived of God) than a delegation of angels upon every turn from heaven, and feems in the main to illuftrate rather than debafe the glory of his nature and exiftence. But however this be, it is plain that the angel here fpoken of was no created being, from the whole context, and efpecially from his faying, "I am the Lord God, the Jehovah," *&c.* fince this is not the language of angels, who are always known to exprefs themfelves in fuch humble terms as thefe, "I am fent from God; I am thy fellow-fervant," *&c.* It is a vain pretence to fay, that an angel, as God's ambaffador, may fpeak in God's name and perfon; for what ambaffador of any prince ever yet faid, "I am the king?" Since therefore no angel, without the guilt of blafphemy, could affume thefe titles; and fince neither God the Father, nor the Holy Ghoft, are ever called by the name of angel, *i. e.* a meffenger, or perfon fent, whereas God the Son is called by the prophet Malachi, (chap. iii. 1.), "The angel of the covenant;" it hence feems to follow, that this angel of the Lord was God the Son, who might very properly be called an angel, becaufe in the fulnefs of time he was fent into the world in our flefh, as a meffenger from God, and might therefore make thefe his temporary apparitions, prefages and forerunners, as it were, of his more folemn miffion.

The Mahometans believe, that one of Mofes's fhoes, put off by him as he drew near the burning bufh, was placed in the ark of the covenant, in order to preferve the memory of this miracle.

BUSHEL, a meafure of capacity for dry things, as grain, fruits, dry pulfe, *&c.* containing four pecks, or eight gallons, or one-eighth of a quarter.

A bufhel, by 12 Henry VII. c. 5. is to contain eight gallons of wheat; the gallon eight pounds of troy-weight; the ounce twenty fterlings, and the fterling thirty-two grains, or corns of wheat growing in the midft of the ear.

At Paris, the bufhel is divided into two half bufhels; the half bufhel into two quarts; the quart into two half quarts; the half quart into two litrons; and the litron into two half litrons. By a fentence of the provoft of the merchants of Paris, the bufhel is to be eight inches two lines and a half high, and ten inches in diameter; the quart four inches nine lines high, and fix inches nine lines wide; the half quart four inches three lines high, and five inches diameter; the litron three inches and a half high, and three inches ten lines in diameter. Three bufhels make a minot; fix, a mine; twelve, a feptier; and an hundred and forty-four, a muid. In other parts of France the bufhel varies.

Oats are meafured in a double proportion to other grains, fo that twenty-four bufhels of oats make a feptier, and 288 a muid. The bufhel of oats is divided into four picotins, the picotin into two half quarts, or four litrons. For falt, four bufhels make one minot, and fix a feptier; for coals, eight bufhels make one minot, fixteen a mine, and 320 a muid; for lime, three bufhels make a minot, and forty-eight minots a muid.

BUSKIN, a kind of fhoe, fomewhat in manner of a boot, and adapted to either foot, and worn by either fex.

This part of drefs, covering both the foot and midleg, was tied underneath the knee; it was very rich and fine, and principally ufed on the ftage by actors in tragedy. It was of a quadrangular form, and the fole was fo thick, as that, by means thereof, men of the ordinary ftature might be raifed to the pitch and elevation of the heroes they perfonated. The colour was generally purple on the ftage: herein it was diftinguifhed from the fock, worn in comedy, that being only a low common fhoe. The bufkin feems to have

have been worn, not only by actors, but by girls, to raiſe their height: travellers and hunters alſo made uſe of it, to defend themſelves from the mire.

In claſſic authors, we frequently find the buſkin uſed to ſignify tragedy itſelf, in regard it was a mark of tragedy on the ſtage.

It is alſo to be underſtood for a lofty ſtrain, or high ſtyle.

BUSS, in maritime affairs, a ſmall ſea-veſſel, uſed by us and the Dutch in the herring-fiſhery, commonly from forty-eight to ſixty tons burden, and ſometimes more: A buſs has two ſmall ſheds or cabins, one at the prow, and the other at the ſtern; that at the prow ſerves for a kitchen.

Every buſs has a maſter, an aſſiſtant, a mate, and ſeamen in proportion to the veſſel's bigneſs: the maſter commands in chief, and without his expreſs order the nets cannot be caſt, nor taken up; the aſſiſtant has the command after him; and the mate next, whoſe buſineſs is to ſee the ſeamen manage their rigging in a proper manner, to mind thoſe who draw in their nets, and thoſe who kill, gut, and cure the herrings, as they are taken out of the ſea: The ſeamen do generally engage for a whole voyage in the lump. The proviſion which they take on board the buſſes, conſiſt commonly in biſket, oat-meal, and dried or ſalt fiſh; the crew being content for the reſt with what freſh fiſh they catch. See FISHERIES.

BUST, or BUSTO, in ſculpture, *&c.* a term uſed for the figure or portrait of a perſon in relievo, ſhewing only the head, ſhoulders, and ſtomach, the arms being lopped off: it is uſually placed on a pedeſtal or conſole.

M. Felibien obſerves, that though, in painting, one may ſay a figure appears in buſto, yet it is not properly called a buſt; that word being confined to things in relievo. The buſt is the ſame with what the Latins called *herma*, from the Greek *hermes*, Mercury, the image of that god being frequently repreſented in that manner by the Athenians.

BUSTARD, in ornithology. See OTIS.

BUSTUARII, in Roman antiquity, gladiators who fought about the buſtum, or funeral pile of a deceaſed perſon of diſtinction, in the ceremony of his obſequies.

This cuſtom was found to be leſs barbarous than the firſt practice was of ſacrificing captives at the buſtum, or on the tomb of warriors; inſtances whereof we meet with both in Roman and Greek antiquities: the blood ſpilt on this occaſion, was ſuppoſed to appeaſe, by way of ſacrifice, the infernal gods, that they might be more propitious to the manes of the deceaſed.

BUSTUARIÆ MOECHÆ, according to ſome, women that were hired to accompany the funeral, and lament the loſs of the deceaſed: but others are of opinion, that they were rather the more common proſtitutes, that ſtood among the tombs, graves, and other ſuch lonely places.

BUSTUM, in antiquity, a pyramid or pile of wood upon which were anciently placed the bodies of the deceaſed, in order to be burnt. Some authors ſay, that it was properly called buſtum after the burning, *quaſi bene uſtum*; that before the burning it was called *pyra*, and during the burning, *rogus*.

The buſtum in the Campus Martius was encompaſſed round with white ſtone, and an iron rail.

BUTCHER, a perſon who ſlaughters cattle for the uſe of the table, or who cuts up and retails the ſame.

Among the ancient Romans, there were three kinds of eſtabliſhed butchers, whoſe office was to furniſh the city with the neceſſary cattle, and to take care of preparing and vending their fleſh. The ſuarii provided hogs; the pecuarii or boarii, other cattle, eſpecially oxen; and under theſe was a ſubordinate claſs, whoſe office was to kill, called lanii, and carnifices. To exerciſe the office of butcher among the Jews with dexterity, was of more reputation than to underſtand the liberal arts and ſciences. They have a book concerning ſhamble-conſtitution; and in caſe of any difficulty, they apply to ſome learned rabbi for advice: nor was any allowed to practiſe this art, without a licence in form; which gave the man, upon evidence of his abilities, a power to kill meat, and others to eat what he killed; provided he carefully read every week for one year, and every month the next year, and once a quarter during his life, the conſtitution above mentioned. We have ſome very good laws for the better regulation and preventing the abuſes committed by butchers. A butcher that ſells ſwine's fleſh meazled, or dead of the murrain, for the firſt offence ſhall be amerced; for the ſecond, have the pillory; for the third, be impriſoned and make fine; and for the fourth, abjure the town. Butchers not ſelling meat at reaſonable prices, ſhall forfeit double the value, leviable by warrant of two juſtices of the peace. No butcher ſhall kill any fleſh in his ſcalding-houſe, or within the walls of London, on pain to forfeit for every ox ſo killed, 12 d. and for every other beaſt, 8 d. to be divided betwixt the king and the proſecutor.

BUTCHER-BIRD, in ornithology. See LANIUS.

BUTCHER'S-BROOM, in botany. See RUSCUS.

BUTE, an iſland of Scotland, lying in the mouth of the frith of Clyde, ſouth of Cowal in Argyleſhire. It gives the title of earl to a branch of the Stuart family. Bute and Cathneſs ſend only one member to parliament between them, each chooſing in its turn, whereof Bute has the firſt.

BUTEO, in ornithology, the trivial name of a ſpecies of falco. See FALCO.

BUTLER, the name anciently given to an officer in the court of France, being the ſame as the grand echanſon, or great cup-bearer of the preſent times.

BUTLER, in the common acceptation of the word, is an officer in the houſes of princes and great men, whoſe principal buſineſs is to look after the wine, plate, *&c.*

BUTLERAGE of wine, is a duty of two ſhillings for every ton of wine imported by merchants ſtrangers; being a compoſition in lieu of the liberties and freedoms granted to them by king John and Edward I. by a charter called *charta mercatoria*.

Butlerage was originally the only cuſtom that was payable upon the importation of wines, and was taken and received by virtue of the regal prerogative, for the

the proper use of the crown. But for many years past, there having been granted by parliament subsidies to the kings of England, and the duty of butlerage not repealed, but confirmed, they have been pleased to grant the same away to some nobleman, who, by virtue of such grant, is to enjoy the full benefit and advantage thereof, and may cause the same to be collected in the same manner that the kings themselves were formerly wont to do.

BUTMENTS, in architecture, those supporters or props on or against which the feet of arches rest.

BUTMENT is also the term given to little places taken out of the yard or ground-plot of a house, for a buttery, scullery, *&c.*

BUTOMUS, in botany, a genus of the enneandria hexagynia class. It has no calix; the corolla consists of six petals; and the capsules are six, containing many seeds. There is but one species, *viz.* the umbellatus, flowering-rush, or water-gladiole, a native of Britain.

BUTRINTO, a port-town of Epirus, or Canina, in Turky in Europe, situated opposite to the island of Corfu, at the entrance of the gulph of Venice: E. long. 20° 40′, N. lat. 39° 45′.

BUTT, in commerce, a vessel or measure of wine, containing two hogsheads, or 126 gallons. See PIPE.

BUTT, or BUTT-ENDS, in the sea-language, are the fore-ends of all planks under water, as they rise, and are joined one end to another.

Butt-ends in great ships are most carefully bolted; for if any one of them should spring or give way, the leak would be very dangerous and difficult to stop.

BUTTER, a fat unctuous substance, prepared from milk by heating or churning it.

It was late ere the Greeks appear to have had any notion of butter; their poets make no mention of it, and yet are frequently speaking of milk and cheese.

The Romans used butter no otherwise than as a medicine, never as a food.

The ancient Christians of Egypt burnt butter in their lamps instead of oil; and in the Roman churches, it was anciently allowed, during Christmas time, to burn butter instead of oil, on account of the great consumption of it otherways.

For the making of butter, when it has been churned, open the churn, and with both hands gather it well together, take it out of the butter-milk, and lay it into a very clean bowl, or earthen pan; and if the butter be designed to be used sweet, fill the pan with clear water, and work the butter in it to and fro, till it is brought to a firm consistence of itself, without any moisture. When this has been done, it must be scotched and sliced over with the point of a knife, every way as thick as possible, in order to fetch out the smallest hair, mote, bit of rag, strainer, or any thing that may have happened to fall into it. Then spread it thin in a bowl, and work it well together, with such quantity of salt as you think fit, and make it up into dishes, pounds, half pounds, *&c.* The newer the butter is, the more wholesome and pleasant it is; and that which is made in May, is esteemed the best.

There are as many sorts of butter, as there are different milks of animals whereof to make it: That of the cow is most in use. It is used every where, and there is hardly any sauce made without it. The northern people, however, make more use of it than others.

Every barrel of butter, imported from abroad, pays a duty of 3s. $10\frac{20}{100}$d whereof 3s. $4\frac{1}{2}$d. is drawn back on exporting it. Irish butter pays only a duty of 1s. $11\frac{10}{100}$d. the hundred weight; whereof 1s. $8\frac{25}{100}$d. is drawn back on exporting it.

BUTTER among chemists, a name given to several preparations, on account of their consistence resembling that of butter; as butter of antimony, of arsenic, of wax, of lead, of tin. See CHEMISTRY.

BUTTER-BUR, in botany. See PETASITES.

BUTTER-FISH. See BLENNIUS.

BUTTERFLY, the English name of a numerous genus of insects. See PAPILIO.

BUTTERFLY-FISH, a species of the blennius. See BLENNIUS.

BUTTERFLY-SHELL, in natural history. See VOLUTA.

BUTTERIS, in the menage, an instrument of steel, fitted to a wooden handle, wherewith they pare the foot, or cut the hoof of a horse.

BUTTER-MILK, a kind of serum that remains behind, after the butter is made.

BUTTER-WORT, in botany. See PINGUICULA.

BUTTERY, a room in the houses of noblemen and gentlemen, belonging to the butler, where he deposites the utensils belonging to his office, as table linen, napkins, pots, tankards, glasses, cruets, salvers, spoons, knives. forks, pepper, mustard, *&c.*

BUTTOCK *of a ship*, is that part of her which is her breadth right astern, from the tack upwards; and a ship is said to have a broad or a narrow buttock, according as she is built broad or narrow at the transum.

BUTTON, an article of dress, serving to fasten cloaths tight about the body, made of metal, silk, mohair, *&c.* in various forms. Metal-buttons are either cast in moulds, in the manner of other small works, (see FOUNDERY), or made of thin plates of gold, silver, or brass, whose structure is very ingenious, though but of little use.

Buttons of all sorts are prohibited to be imported.

BUTTON, among gardeners, denotes much the same with bud. See BUD.

BUTTON, in the menage. Button of the reigns of a bridle, is a ring of leather, with the reins passed thro' it, which runs all along the length of the reins. To put a horse under the button, is when a horse is stopped without a rider upon his back, the reins being laid on his neck, and the button lowered so far down that the reins bring in the horse's head, and fix it to the true posture or carriage. It is not only the horses which are managed in the hand that must be put under the button; for the same method must be taken with such horses as are bred between two pillars, before they are backed.

BUTTON'*s-bay*, the name of the north part of Hudson's bay, in North America, whereby Sir Thomas Button

Button attempted to find out a north-weſt paſſage to the Eaſt Indies. It lies between 80° and 100° W. long. and between 60° and 66° N. lat.

BUTTRESS, a kind of butment built archwiſe, or a maſs of ſtone or brick, ſerving to prop or ſupport the ſides of a building, wall, &c. on the outſide, where it is either very high, or has any conſiderable load to ſuſtain on the other ſide, as a bank of earth, &c.

Buttreſſes are uſed againſt the angles of ſteeples and other buildings of ſtone, &c. on the outſide, and along the walls of ſuch buildings as have great and heavy roofs, which would be ſubject to thruſt the walls out, unleſs very thick, if no buttreſſes were placed againſt them. They are alſo placed for a ſupport and butment againſt the feet of ſome arches, that are turned acroſs great halls in old palaces, abbeys, &c.

BUTZAW, a town of Lower Saxony, in Germany; it ſtands upon the river Varnow, on the road from Schwerin to Roſtock.

BUXTON, a place in the peak of Derbyſhire, celebrated for medicinal waters; the hotteſt in England, next to Bath.

Buxton-*wells*. The ſtrata of earth and minerals, in the parts adjacent to Buxton, are peat-moſs, blue clay, iron, and coal, mixed with ſulphur and brazil.

The warm waters there, at preſent, are the bath, which takes in ſeveral warm ſprings; St Ann's well, a hot and cold ſpring riſing up into the ſame receptacle; and Bingham-well.

Theſe waters greatly promote digeſtion, unleſs they are drunk too long, in which caſe they relax the ſtomach, and retard digeſtion; they are well adapted to obſtructions of every kind, whence they produce ſurpriſing effects in gouty, rheumatic, athritic, and ſcorbutic pains. As this water is warm, highly impregnated with a mineral ſteam, vapour, or ſpirit, it is ſignally beneficial to cramps, convulſions, dry aſthmas, the bilious colic, ſtiffneſs, &c.

They adviſe both drinking and bathing in the uſe of theſe waters; only the laſt is of bad conſequence in the gout, inward inflammations, fevers, dyſentery, large inward tumours, or in an outward preſſure of the body.

BUXUS, in botany, a genus of the monœcia tetrandria claſs. The calix of the male conſiſts of three leaves; and the corolla has two petals: The calix of the female has four leaves; the petals are three; it has three ſtyli; and the capſule has three cells containing two ſeeds. There is but one ſpecies, *viz.* the ſempervirens, or box-tree, a native of Britain. A decoction of the leaves and wood has been recommended as a powerful ſudorific; but is not now uſed by practitioners. The wood is of a hard cloſe texture, and is greatly uſed by mechanics for tools of various kinds.

BUYS, a town of Dauphine, in France, ſituated on the confines of Provence; E. long. 5° 20′, and N. lat. 44° 25′.

BUZZARD, in ornithology, the Engliſh name of ſeveral ſpecies of the hawk kind. See Falco.

BYGHOF, or Bygow, a city of Lithuania in Poland, ſituated on the river Nieper; E. long. 30°, and N. lat. 53°.

BY-LAWS, or Bye-laws, private and peculiar laws for the good government of a city, court, or other community, made by the general conſent of the members.

All by-laws are to be reaſonable, and for the common benefit, not private advantage of any particular perſons, and muſt be agreeable to the public laws in being.

BYRLAW, or Burlaw *laws*, in Scotland, are made and determined by neighbours, elected by common conſent in byrlaw courts. The men choſen as judges, are called byrlaw or burlaw men, and take cognizance of complaints between neighbour and neighbour.

BYRRHUS, in zoology, an order of inſects belonging to the order of coleoptera. The feelers are clavated, pretty ſolid, and a little compreſſed. There are five ſpecies, all of which are to be found on particular plants, and principally diſtinguiſhed from each other by the colour and figure of the elytra or cruſtaceous wing-caſes.

BYSSUS, in botany, a genus of moſſes belonging to the cryptogamia algæ. The character is taken from this circumſtance, that they are covered with a ſimple capillary filament or down, reſembling ſoft duſt. The ſpecies are 15, all natives of Britain.

BYSSUS, in antiquity, that fine Egyptian linen whereof the tunics of the Jewiſh prieſts were made.

Philo ſays, that the byſſus is the cleareſt and moſt beautiful, the whiteſt, ſtrongeſt, and moſt gloſſy ſort of linen; that it is not made of any thing mortal, that is to ſay, of wool, or the ſkin of any animal, but that it comes out of the earth, and becomes always whiter, and more ſhining, when it is waſhed as it ſhould be.

BYZANT. See Bezant.

BYZANTIUM, the ancient name of Conſtantinople. See Constantinople.

BZO, a town of Africa, in the kingdom of Morocco.

End of the First Volume.

E R R A T A.

Page 127. column 2. end of the firſt paragraph, read *Plate XI. fig.* 3.; and at the end of the next paragraph, *Plate XI. fig.* 2.

End of the article AMPHISBOENA, read *Plate XII. fig.* 2.

St ANDREW'*s day.* For the *thirteenth*, read the *thirtieth* of November.

Page 466. col. 1. l. 52. for *vkA*, read ikA.

Page 467. col. 1. l. 12. ſupply *Plate XLIII. fig.* 4. to which the reference-letters and figures in the paragraph belong.

Page 468. col. 1. l. 26. for *fig.* 3. read *fig.* 5.

In fig. 9. of Plate LI. the *Baſton*, or *Baſtard-bar*, is repreſented in a wrong direction. It ſhould run thus, .

BOS. End of par. 2. *del.* Plate LII. fig. 2. which is not a figure of the common bull, but of the *Biſon*, deſcribed p. 625. col. 2.

In the article BRETON, for *ſubject to the Engliſh*, read *ſubject to the Britiſh*.

Plate 47. repreſents a different Orrery from the one deſcribed. The right one will be engraven, and delivered in due time.

BOOK-KEEPING. A variety of preliminary Problems, Caſes, *&c.* referred to by the letters and numbers which the reader will obſerve ſubjoined to the examples in the Waſte-book, were by accident omitted in the printing; but will be printed and given in proper time, with directions for inſerting them. —*So that this and the preceding article may be expunged from this* liſt *when the book is bound.*

*** It is humbly hoped, that the above faults, with others which may have eſcaped notice, or are here omitted as trivial, will be candidly deemed venial in a work ſo complex, ſo various, and ſo extenſive as the preſent.